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P A P E R S

IN

M E C H A N I C S.

Nº I.

WROUGHT-IRON GUN-CARRIAGE.

The SILVER VULCAN MEDAL was this Session given to MR. R. PERING, Clerk of the Checque, ROYAL DOCK YARD, PLYMOUTH, for a WROUGHT-IRON GUN-CARRIAGE for Naval Service. The following Communication on the subject has been received from him, and a Model of the Carriage has been placed in the Repository of the Society.

SIR;

Plymouth Yard, Dec. 21st, 1821.

I REQUEST that you will do me the honour of laying before the Society for the Encouragement of Arts, Manufactures, and Commerce, the accompanying documents, and model of a Wrought-Iron Gun-Carriage, invented by me for the naval service. The advantages which I conceive it to

possess over the timber carriages at present in use are, first, that it is not liable to splinter when struck by a shot in action, and therefore the people working the gun are less likely to be wounded on such an occurrence taking place. Secondly, the surface of the pieces composing the carriage being less than that of the same when made of wood, nearly in proportion to the specific gravities of the two materials, an iron carriage is less exposed to be struck, and consequently to be crippled, than a wooden one. For the same cause, the gun-deck will be less crowded, and more clear space will be left for fresh air; a circumstance not to be neglected, since it conduces to the health and comfort of the crew.

I am, Sir,

A. Aikin, Esq.

&c. &c.

Sec. &c. &c.

RICH. PERING.

A REPORT of *Sir JOHN DUCKWORTH, Admiral and Commander in Chief of his Majesty's ships and vessels at Plymouth, to the Admiralty, on two WROUGHT-IRON GUN-CARRIAGES, invented by MR. PERING, to act as substitutes before the Ship comes into Port, in case any of the Wooden Carriages should be disabled in action, as no spare ones are ever taken to Sea.*

Impregnable, Feb. 4th, 1817.

“ I HAVE caused two Wrought-Iron Gun-Carriages, invented by Mr. Pering, to be tried in the presence of Commissioner Shield and myself, Captains Ekins, Broughton, Nash, King. The two carriages were put on board the *Eridanus*, and one of the main-deck guns of that ship was mounted on each of them. The gun was fired eleven times

without reducing the charge of powder, and eight of those eleven times double-shotted. There were not greater intervals between the firing, than there usually are in action.

“ A gun mounted on the ordinary ship carriage was fired occasionally, for the sake of comparison.

“ In the course of this experiment, we were not able to perceive any properties in which there was in Mr. Pering's carriage any sort of inferiority ; but, on the other hand, it was proved to answer its purpose perfectly ; and to possess the advantage of being worked with more facility than the wooden carriage in the proportion of four to five. As an instance of its superiority in this respect, the gun on the wooden carriage was run out, and so was that of the iron. Two men were desired to apply their strength to the former, and endeavour to run it in, but they were not able to move it. The same men were then applied to the latter, and brought it in with ease. The diminished friction in the iron carriage is sufficient to account for the advantage which it thus possesses. The absolute weight of the iron carriage is precisely that of the wooden, viz. six hundred weight and a half.

The qualities in which the iron carriage cannot fail to be superior to the wooden, are, its durability, and its diminished occupation of space. On the value of the former quality it is not necessary to dwell ; but in estimating the latter, I would beg to observe to their lordships, that we were forcibly struck with the remarkable clearness of space in the neighbourhood of the port ; light and air being admitted where before was a mass of wood ; and the deck appearing clear and unincumbered under the gun. It is also to be considered whether the gain of so much additional room for the circulation of air may not be of advantage on a ship's lower deck, when the ports cannot be kept open.

“ It also appears to us, that, in action, shot might pass

between the different parts of the iron carriage, without striking any; whereas such could not be the case in the wooden carriage.

“ We are also of opinion, that, as the iron carriage is put together by means of screws, a part of it which should be disabled in action might be easily supplied with a spare piece; whereas, a shot can hardly strike a wooden carriage without rendering it entirely useless.

“ The peculiar portability of the iron carriage, fitted as it is for taking to pieces, and occupying so little space, is favourable to the argument of this advantage.

(Signed)

J. T. DUCKWORTH.

His Majesty's Dock Yard, Plymouth,
April 24th, 1821.

The Wrought-Iron Gun-Carriages have been at sea since 4th February, 1817, in three different frigates—the *Eridanus*, captain King; *Tigris*, captain Henderson; and *Spartan*, captain Wise; who express themselves much satisfied with the utility of the invention, as appears from the subjoined reports.

A. Aikin, Esq.

RICH. PERING.

Sec. &c. &c.

SIR;
His Majesty's Ship *Spartan*, Plymouth Sound,
March 3rd, 1819.

IN obedience to their lordships' order, signified to me by your letter of the 1st instant, I beg to give it as my opinion, that Mr. Pering's Wrought-Iron Gun-Carriages answer very well in every respect. The principal advantages appear to be—1st, the ease of working the gun; which, perhaps, may be stated as five, or even four to six, in comparison with the wooden carriages;—2ndly, (and this is, I think, a most material

consideration), the much less chance of the carriage being struck by shot ;—3rdly, if it should be struck, the still less chance of its being rendered unserviceable ;—and, 4thly, the ease with which, in the latter case, it can be replaced by spare ones, as they can be taken to sea in a very small compass ; there is also less danger to be apprehended from splinters. The weight I understand to be the same as the wood carriage, but this I have no means of ascertaining. I have fired twenty rounds in twenty-eight minutes ; the first seven double-shotted, with a full charge of powder, the next four single-shotted, with a full charge ; and the remaining nine single-shotted, with a reduced charge. The gun stood it remarkably well—indeed no gun could answer better. I should recommend the edges of the carriages to be rounded, and a vacancy to be left in the centre of the up and down part of the bed, for the purpose of hooking the train tackle. I have heard it remarked, that side rings for the breeching would be an improvement, but I am very much inclined to be of a different opinion. I am sure a carronade answers better without them ; and in the trials I have made upon this occasion, I did not at all find the want of them, for the gun was remarkably quiet (if I may use the expression) the whole time. I think, if the carriages were heated and varnished in the same way we varnish shot for the lockers, it would preserve them far better than paint.

I am, &c.

(Signed)

W. F. WISE, *Captain.*

SIR ;

Tigris, Portsmouth, Jan. 9th, 1821.

IN pursuance of your order to me of the ultimo, I proceeded to Plymouth, and received the two iron carriages invented by Mr. Pering, and have since made various trials of them, by constant exercising and repeatedly firing from

them, with single and double shot and full charge of powder, both when the ship has had considerable motion, and otherwise; during which trials they have answered every expectation I could have formed of them.

I am of opinion, there is much to approve, and nothing to condemn in them. They will, I think, require some trifling alterations, which I have remarked at the bottom of this letter.

I do not take upon myself to say, what might be the effect in a long and severe action, but as far as opinion goes, mine is decidedly favourable to them.

The advantages I speak of are :

1st, That they are not liable to splinter, when struck by shot.

2ndly, That they admit a free circulation of air along the deck.

3rdly, That they are worked with much more ease; saving, I think, two men in ten.

4thly, That any part of them can be conveniently replaced, if injured in action, by spare ones carried in the hold, as they would take up very little room, being taken apart.

5thly, Their durability.

6thly, The mode of housing the gun, I consider a good one, and an improvement.

Perhaps it may be thought necessary to give the whole of the carriage a little more substance, although they appear to stand the trials they have had on board here perfectly well; at all events, it will be proper to take care that none but the best iron is used in making every part of the carriage, and that the workmanship should be good; with that caution, and the little alterations I have pointed out, I should consider them, as far as my judgment goes, very superior to the wooden carriage or any other I have seen.

(Signed)

R. HENDERSON.

*Reference to the Engraving of Mr. PERING's Wrought-Iron
Gun-Carriage, Plate II.*

Fig. 7 is a side view of the carriage and gun, showing the position of the bars for giving a good support; the two side plates, or frames, *l* and *m*, are secured together by four iron rods, *n*, *o*, *p*, and *q*, with screw nuts at each end, and by the two axle-trees *r* and *s*, seen best in the plan fig. 8, and in the front elevation fig. 9 (the same letters showing the same parts in all the figures). The axle-trees have two elbows, or brackets, *t*, *t*, rising from the upper surfaces, to which the side frames are bolted; *v v*, a platform on which the wedge *u* is laid to support the breech. Fig. 10 shows a side view of the platform, separate, with the wedge *u* on it; the square hook *s* fits on the hinder axle-tree, or the small hook *n* will hang on the hindmost rod *n*. Fig. 11 shows a back elevation of the platform, with the hooks *n n*; *w w*, two additional holes into which the hooks *n n* may be screwed, if required: at the front end of the platform is a notch, *o*, fig. 10, to rest on the iron rod *o*, figs. 8, 9; at one side, and at the bottom of the wedge, are two studs or \vdash hooks *x*, figs. 9 and 10, to slide in the slit of the platform, as seen in fig. 8, by which the wedge may be used either direct or lying on its side, according to the elevation intended to be given to the gun. Fig. 12 shows the joint *y* open to put in or take out the gun; it is fastened by a pin *z*, going into the hole *z*; *e e e e*, fig. 8, four rings by which the carriage is secured.

N° II.

LIFE BEACON.



The large SILVER MEDAL and TEN GUINEAS, were this Session presented to Mr. GEORGE HOLDITCH, Keeper of the Buoys and Beacons of the Port of Lynn, Norfolk, for his LIFE BEACON. The following Communication has been received from Mr. Holditch, and a Model of his Apparatus has been placed in the Repository of the Society.

SIR;

Lynn Regis, October, 1821.

ALTHOUGH the establishment of Life Beacons on dangerous sands at sea has been long practised; yet their construction has hitherto been far from perfect, and the expense of erecting them has generally been so considerable as to restrict them to a very few situations. The beacon which is the subject of the present communication, will, I believe, be found to be free, in a great degree, from both these objections: I have, therefore, forwarded a model of it to the Society for the Encouragement of Arts, Manufactures, and Commerce, for their inspection and judgment, in hopes that it may meet with their approbation; and obtain, through the medium of their Transactions, that publicity which may lead to its general adoption. I flatter myself that the lives of many valuable seamen engaged in the laborious and hazardous navi-

gation of the coasts of this kingdom, may thus be saved to their families, and to the community at large.

GEORGE HOLDITCH,
Buoy and Beaconer.

In the year 1812, the channel leading to and from the port of Lynn, altered about five miles to the westward, which brought the ships, in their course up and down this navigation, near a sand called the Longsand, which is very steep, and about six miles from the nearest shore. This caused a general wish from the shipmasters of the port to have a beacon placed upon this sand, if possible. A petition was accordingly drawn up and presented to the corporation of Lynn, requesting them to bear the expense of the same, which they readily granted.

I immediately set about the work. In the first place, a ten inch square main-piece was driven into the sand twelve feet, with a topmast 36 feet above the level of the sand, and four posts were driven seven feet into the sand for brace-posts; but as soon as there was a heavy sea from the eastward, and a gale of wind, the motion of the braces shook the posts entirely out of the sand. I then secured the braces by heavy stones let into the sand, which held firm until the heavy gale of wind, March the 2nd, 1820, when the whole was washed down.

In July, 1820, I erected another beacon, the model of which accompanies this statement, and which, from its having remained uninjured to the present time, shows, that the imperfections in the construction of the first beacon have been successfully avoided.

The main-piece is a tree of English oak of the best quality, 27 feet long and 12 inches square, shod with iron for four feet, and for five feet above filled close with scuppers (short large headed nails). It was bound round at its upper end

with three strong iron hoops, to prevent it from splitting, and being thus prepared, was driven about 16 feet into the sand by means of a crane and beetle of 13 cwt.

The topmast is made of a good red wood spar, 37 feet long, and tapering off from 12 inches, its diameter at its base, to $6\frac{1}{2}$ inches, its diameter at the top. It is secured to the main-piece by two stout iron clasps and screw bolts; and to the upper of these clasps are fixed four rings or eyes, to serve as the attachment of as many bars of iron, $1\frac{1}{2}$ inch square and 28 feet long. The lower end of each bar is bolted to a flat block of stone weighing 6 cwt. The stone is buried in the sand, and in a month or two gets so firmly embedded by the tremulous motion impressed by the sea on the shaft, that it would form a secure mooring for a vessel of 100 tons.

A similar iron clasp, with eye bolts, is fixed round the topmast, about eight feet from its summit, and to this are attached four chains, each having a block of stone of 4 cwt. at the other end. These stones, like the others, soon get buried in the sand, so as to keep the chains in a state of tension, and consequently give additional support to the beacon. Just above the upper clasp are three short spars, forming an inverted triangle for the purpose of supporting more firmly the seats which are fixed to the topmast, each piece being terminated by a head of light basket-work, in order to render the beacon more conspicuous. From the seats down to the bottom of the shaft, are cleats, by which, with the assistance of a chain for a man-rope, a sailor or other person may easily ascend to the top of the beacon.

The beacon is erected on the highest part of the Longsand, so that, even in thick weather, persons who may be upon the sand will naturally, as the water rises, be directed to it. Nor is this matter of mere speculation; for three weeks after it

was erected, two men belonging to his majesty's surveying brig, Protector, lost their way in a fog on this very sand and were preserved by retreating before the advancing tide till they arrived at the beacon.

The distance from which it is visible in clear weather without a glass is about seven miles, it being seen from Boston and Lynn Knock buoys to the N. E., from Hunstanton cliff to the S., and from buoy No. 2 in Lynn well to the W.

The utility of such a beacon on islands of sand which are covered at high water will, I trust, induce other corporations to erect them in suitable places within their jurisdiction.

The average expense of such a beacon on a sand like ours, seven feet above low water mark, would be about £.80.

G. H.

Reference to the Engravings, Plate 9.

Fig. 1 represents the life beacon, consisting of the main-piece, secured by two clasps to the topmast, with the iron bars and large blocks of stone, and the iron chains and smaller blocks by which the beacon is prevented from being forced out of the sand. It also shows the cleats, the man-rope, the seats on the inverted triangle, and the basket-work heads by which it is terminated—the whole being on a scale of one-twelfth of an inch to a foot.

Fig. 2 is a lateral elevation of the upper part of the topmast, showing the seats, the man-rope, and the iron clasp to which the four chains are fixed.

Fig. 3 is a plan of the clasp to which the four iron bars are attached.

Figs. 2 and 3 are on a scale of $\frac{1}{4}$ of an inch to a foot.

CERTIFICATES.

SIR ;

Lynn Regis, October, 1821.

THE buoy and beaçoner of this port, Mr. George Holditch, having requested my opinion of a life beacon erected by him on a dangerous sand called the Longsand, at the entrance of this channel from the sea, I beg leave to state, that I think it is calculated fully to answer the purpose for which it was intended. It is an invention of his own, and I have no doubt, if the great benefits likely to result from it to mariners were generally known, it would be applied to similar places, as far as practicable.

I have the honour to be, Sir,

A. Aikin, Esq.

Your most obedient servant,

*Sec. &c. &c.*THOMAS ALLEN, *Mayor.*

Lynn, October 26th, 1821.

THIS is to certify, that I have cruized up and down Lynn Well, and have found the beacon on the Longsand, erected by Mr. George Holditch, to be a most useful mark for the above place, and in consequence of shipwreck, would be found particularly serviceable in saving the lives of the people.

JOHN LEAFORD,

Commander of the Erin.

N° III.

BRIDLE BIT.

The Large SILVER MEDAL was this Session given to Mr. C. GOODWIN, of London Wall, Saddler, for an improved BRIDLE BIT. The following Communication was received from the Candidate, and a Bridle-bit of his invention has been placed in the Repository of the Society.

SIR;

42, London Wall,
26th March 1822.

HEREWITH I send my new-invented bridle-bit, which I will thank you to lay before the Society for the Encouragement of Arts, Manufactures, and Commerce. In the common bridle-bit, billets or loops are fixed upon the cheek, through one of which the end of the rein is passed, and secured by a buckle. Each billet being at a different distance from the center of motion, the leverage of the rein may be adjusted to any required degree, by fixing it to a billet nearer to or farther from the center. Occasions frequently occur on a journey for changing the leverage, which is not very easily effected when the fingers are numbed with cold, nor very safely with a restive horse, since in the process of changing the bearing, the rein must for a time be completely disengaged from the bit,

and the horse may then start off in a perfectly unmanageable state.

The bit which I have the honour of now submitting to the Society, obviates the possibility of accidents from this cause, there being only one billet moveable on the cheek or lever, and therefore admitting of the bearing being changed in an instant, and without the trouble and hazard of unbuckling the rein. Several of these bits have been sold by me, and have given complete satisfaction, as the annexed certificate will show.

I am, Sir,

A. Aikin, Esq.

&c. &c. &c.

Sec., &c. &c.

CHARLES GOODWIN.

CERTIFICATE.

SIR ;

Charles-street, St. James's,
February 5th 1822.

I HAVE tried your new-invented driving bit, and in my opinion, it is admirably calculated to remedy a defect which all other bits have.

The substantial utility of your invention, appears to me, not to consist in the mere power of adapting readily the same bit to different horses, but of affording those who use harness horses, an easy, simple, and above all, a safe mode of altering the reins, when the horse is in a carriage. For many *unmade* horses have peculiarities in their mouths, which renders it necessary to alter the position of the reins on the bit frequently whilst driving them, and to do this in the common bit is not only tedious and often difficult, but attended with a good deal of risk. The horses where such attentions are necessary, are generally high-couraged and impetuous, so that, whilst the rein is unbuckling, the animal is under little control, and

many instances have occurred, where horses under such circumstances have got loose, and been the cause of serious accidents.

I am, Sir,

Mr. Goodwin,
Bit-Maker.

&c. &c. &c.

JAMES WARDROP.

Reference to the Engraving of Mr. C. Goodwin's Bridle Bit.—

PLATE IX.

FIG. 4, shows a perspective view of the bit, *a c a c* the two levers which are cylindrical having (instead of billets or loops) three cylindrical portions, which are divided from each other by the ridges *d* and *e*, *d* and *e*; *b b*, the two billets, with collars to slide up and down the levers; this, however, cannot take place, on account of the ridges, unless when the billet is brought half round, as shown by dotted lines in fig. 5, for on that side, the collars have a groove to pass over the ridges, as shown in fig. 6, where *b* is the billet and its collar, and *c* a section of the lever and ridge; so that instead of having to unbuckle as in the old mode, the billet collar is turned half way round, as in fig. 5, where by dotted lines the collar is shown sliding over the ridge to the required part of the lever, and then turned back again as *b*; but lest by any accident the billet by being shaken half round should slide down of itself, the collar on the outside of each billet is left a little longer at the bottom, near the loop (as *b b b*, figs. 5, and 6), by which it cannot turn round to pass between the ridges, on the outside, and the motion on the inside, is sufficiently guarded by the horse's neck preventing the reins from falling that way.

N° IV.

IMPROVED BISTOURY.

The Large SILVER MEDAL was this Session given to Mr. J. MILLIKIN, 301 Strand, for an improved BISTOURY. The Instrument has been placed in the Repository of the Society.

THE common bistoury is a slender curved knife, employed by surgeons in opening sinuses, and deep-seated ulcers of particular kinds. But from the form of the instrument, and the local circumstances of the diseased parts, it is hazardous in use, unless a director has been previously introduced to guide the surgeon in the introduction of the bistoury. This however occasions additional suffering to the patient, and requires the presence of an assistant.

Mr. Millikin has combined the director and knife in one instrument, by perforating the handle, and introducing through this a steel plate, of the same width and curvature as the knife, which closely applying itself to this latter, completely prevents it from doing mischief during its introduction, and is withdrawn afterwards without difficulty, by the finger of the operator.

Fig. 7, plate IX, is a back view ; and fig. 8, a side view of the instrument. Fig. 9 is the knife with one of the scales of the handle removed, to show the curved groove in which the lower part of the guard *i k* is deposited, and through which it is withdrawn, by making pressure with the finger on the side of the stud *k* ; *g g*, is the blade entirely sheathed by the guard *i* in fig. 7, and partially so in fig. 8 ; the base of the blade is carried down to the bottom of the handle at *h* ; *l* and *m*, fig. 9 show two pieces of iron inserted in the handle, and forming the groove through which the guard passes.

N^o V.

SHIP'S COMPASS.

The Large SILVER MEDAL was this Session given to Mr. R. PIKE LITTLEWORT, Lieut. R. N., for an improved SHIP'S COMPASS, a Model of which has been placed in the Repository of the Society.

THE kinds of compasses used on ship-board, are the binnacle or steering compass, the hanging compass, suspended in the cabin to enable the captain to ascertain whether the steersman is attentive to his duty (and hence often called the *tell-tale*), the amplitude compass, and the azimuth compass ; this latter, being for the purpose of observing the sun or other heavenly body and thence obtaining the variation of the needle, is only occasionally employed.

In merchant ships, except those of the largest class, the azimuth compass is generally dispensed with, because this instrument is costly, requires for its use a greater knowledge of navigation, than masters of merchant ships are usually possessed of, and although of great utility, is not an article of absolute indispensable necessity.

The object of Lieut. Littlewort is to render the hanging compass convertible into an azimuth compass, and thus to enable masters of ships to obtain at an easy cost an instrument, the utility of which is unquestioned, and the employment of which will contribute at the same time to the safety of the ship, and to their own improvement in the higher branches of navigation.

Lieut. Littlewort's compass, like the better kinds of common compasses, has two cards, one light and very moveable, for fine weather, and another heavier, for use when the vessel has much motion: this latter lieut. Littlewort has weighted by fixing on its circumference an accurately graduated silver circle; and this it is which is employed when the compass is used for azimuths. The handle by which the compass is suspended to the roof of the cabin, is capable of being inverted and of supporting the compass by sliding in a groove made in a box, which box is capable of motion, on a central pin fixed in the board on which the box stands; moveable sights and a stop are also annexed, which enable it to act when required as an azimuth compass.

The parts will be better understood by reference to the engraving, Plate X., figs. 1, 2, and 3.

Fig. 1, shows the compass, one quarter the real size, with the sights *a* and *b* put on, and fixed up as an azimuth compass, by means of the inverted handle *c c*, in the box *d d*; this box is attached to the board *e e* by a pin in its center, on which it turns; *f* a spring pin, which snaps into a hole at *g*,

to fix the box when required; *h*, a stop to press against the card and check its vibrations. When it is used as a hanging compass, the arms or frame *c c*, are drawn out of their grooves in the box and turned up, as the dotted lines *i i*, and fixed to the ceiling by a screw *k*, the sights *a* and *b* being then removed the card is seen through the glass bottom. When used as a steering compass, it is put into the box as if packed up, shown in fig. 2, one-eighth of the real size, where the frame *c c* is held by two blocks of wood *b b*, the box being a little longer that way, to receive the frame without a groove; *m*, the place where the sights *a* and *b* are laid in the box.

Fig. 3, shows the board *e e*, with the spring *f*; *n* the center on which the box turns; *p p p*, three studs to give a better bearing for the box *d d*, and to raise it high enough to clear the spring pin *f*, when that spring is pressed down.

N^o VI.

LIFE-BOAT.



The SILVER VULCAN MEDAL was this Session given to HENRY GORDON, Esq., Capt. R. N., for his apparatus for converting a SHIP'S BOAT, into a LIFE-BOAT. The following Communication has been received from him, and a Model of his invention has been placed in the Repository of the Society.

SIR ;

December 21st, 1821.

WITH a view of giving publicity to a plan for buoying up boats of all dimensions, the draught of which is here presented to the Society for the Encouragement of Arts, Manufactures, and Commerce, I have the honour to transmit you the inclosed statement, descriptive of it.

I am, Sir,

&c. &c. &c.

HENRY GORDON.

London, January, 1822.

The late shipwrecks that have happened, and the number of lives which have been lost, owing to the danger attending boats approaching a wreck in a gale of wind, with a high sea on, when they are not previously or expressly built or pre-

pared for so perilous an enterprise, clearly prove the urgent necessity of adopting some means that may be found adequate to the accomplishment of so important an object.

The writer of this, having paid some attention to the subject, and being thoroughly convinced that it is one of the greatest moment, has visited two ports (Bristol and Rye), where life-boats are kept, and has attentively examined them, and found them both so ponderous and so constructed that he did not approve of either. He objects to the first, because an airtight locker is one of the buoyant principles; to the other, because she was so very heavy that it must take a great many men to launch; to obviate, therefore, all these difficulties, and to make this kind of boat an appendage to every ship, whether merchant or man of war, he has drawn up the present observations and submitted the accompanying draught, with a view to its being inspected by the Society of Arts, &c.; confident that it will be found to answer, because it has been submitted to experiment by the undersigned, who, on the 6th and 7th of December last, caused a boat at Millbank to be totally submerged, got into her in this situation and floated; the buoyant principle was proportioned only for his weight; but the boat would have as easily floated with fifty persons or more on board, had the buoy been proportionately augmented; thus, proving beyond a doubt, that the theory hereafter explained answers a practical purpose even in the most extreme case.

As simplicity and lightness of weight are the two principles on which the plan, now presented, is founded, it requires little reasoning to show how very essentially such a principle recommends itself to sea-faring purposes, it being an indispensable requisite, that a boat should not be one ounce heavier than is necessary, in order that she may be as portable as possible for hoisting in and out-board, and for being

sent in the highest sea and the heaviest gale, to take up a drowning man when fallen from the top-sail yard, either by day or night.

The model of the boat in this draught is calculated to row six oars, which, with a coxswain and midshipman = 8 men, triple this, = 24, being the full complement of men such a boat can contain, and then there will be scarcely room for the rowers to pull freely. The buoy is composed of prime Spanish cork, and consists of eight pieces or rows, each piece being a foot longer than that immediately below it. The pieces are connected to each other by strong cord, thus producing a degree of flexibility in the triangle sufficient to allow of its being closely applied to the boat's side, each layer occupying in breadth a streak of the boat. It farther possesses this great advantage, that it is not a fixture to the boat but may be at any time removed, and when the boat is hoisted in-board or out, always can be unshipped, so that the boat is intrinsically as light as ever; neither would it be necessary to carry it on every occasion, yet it would be the safest way never to leave the ship without it.

It measures at the base, one third of the boat's length, and is supported by split canes or bamboo, tied together by strong cord well covered with shoemaker's wax. The pieces composing each individual row, are secured by longitudinal layers of split bamboo or cane, and being thus constructed, a blow that would stave in the boat, would not penetrate the triangle, owing to its elasticity.

Large boats, such as those capable of holding 100 men, instead of being furnished with a single large triangle on each side, should have three of nine feet each in length; by which many advantages will be obtained. First, that the same triangles would serve for boats of different sizes, and hence the expense of the outfit be very materially reduced; second-

ly, triangles of the above dimensions are more manageable easier put on or taken off and more commodiously stowed away than larger ones. Thus, the launch rowing 24 oars, with 75 men on board, might be fitted in the following manner :—the barge's triangle fixed a-mid-ships, the cutter's on the bow, and the jolly boat's on the quarter, the launch would then be rendered completely buoyant, without any additional expense.

The contrivance possesses at once these advantages : being extremely simple, affording the best security under similar circumstances, being so reasonable in its cost that it is within the reach of every merchant ship to supply herself at a small expense, and is particularly advantageous for the preventive service to approach vessels and visit them when no other boat can ; also, to be sent with dispatches to considerable distances in the open sea, on an emergency ; provided the crew have sufficient provisions to sustain them, to land at Deal, Yarmouth, Madras, and other beaches, when no other boat can : and to take up a drowning man in a gale of wind at sea when no other boat could live.

HENRY GORDON.

Reference to the Engraving of Capt. HENRY GORDON's Life Buoy, Plate X.

FIG. 4, shows the triangular buoy on a scale of three-eighths of an inch to one foot ; fig. 5, an end view : it is formed of pieces of cork one foot long, six inches wide, and about one inch and a quarter thick, laid three thicknesses together and then placed end to end, till of the required length (which is

here nine feet for the upper streak), and then joined into one streak, by lengths of split cane laid on all four sides and sewed well together; the different streaks are fastened together by four ropes $q\ q$, $r\ r$, which are seised together between each streak; when used, the ends s are drawn under the keel till the lower streak touches it, and then brought up over the side and fastened to the thwarts, the two upper ends q and r are also brought over their side and fastened to the thwarts; the other triangle is drawn in like manner on the opposite side of the boat and fastened. Fig. 6 shows the buoy attached to the side of a boat, on a scale of one eighth of an inch to a foot; fig. 7, an end view of a boat, showing both the triangles lying close into the streaks. The triangle here represented, diminishes one foot in each lower streak, the top one being 9 feet, the next 8 feet, and so on, each being 6 inches wide and about 4 inches thick (being made of three layers); two buoys thus made, contain $14\frac{2}{3}$ cubic feet of cork, weighing 226 *lbs.*, 10 *oz.*, and displace 944 *lbs.* 8 *oz.*, of sea water, leaving 717 *lbs.* 14 *oz.* of buoyancy, for a boat 28 feet long containing 24 men.

N^o VII.SYSTEM OF MUSICAL NOTATION FOR THE
USE OF THE BLIND.

The Smaller or VULCAN SILVER MEDAL was this Session presented to Mr. J. WATSON, of the Western Exchange, Bond Street, for a SYSTEM OF MUSICAL NOTATION FOR THE USE OF THE BLIND. The following Communication has been received from Mr. Watson, and one of his Boards with its accompaniments has been placed in the Repository of the Society.

SIR ;

Western Exchange, Old Bond Street,
January, 1822.

I BEG you will do me the favour to lay before the Society of Arts, &c., my System of Musical Notation for the Blind, which I have found to be advantageous in teaching, being, myself, blind from childhood, and which, I flatter myself, will be approved of by the Society ; the following is a description thereof.

I am, Sir,
&c. &c. &c.

JAMES WATSON.

The board containing six staves, is 9 inches broad, 18 long, $\frac{1}{2}$ inch thick, but may be extended to 3, 4, 5, or 6 feet long, and jointed for portability ; each of the staves contains two

raised lines, and a space between the lines, with a space above and below the lines, for ledger lines, as shown by the section fig. 1, plate xi; fig. 2, represents the first portion of the surface of the board, being full of regular rows of holes to receive the pegs; the first stave on the board is treble, the second bass, the third treble, fourth bass, &c., to the bottom of the board, which may be extended to 8 or 10 staves, as may seem best to the user. A crotchet is represented by a plain peg *c*, with a notch in one side, the four different positions of which represent four notes upon the space below the lines in the treble stave, the same four positions of the peg on the first raised line represent the following four notes, and the space, the line, and the space above the lines, each four notes more through the gamut: as shown by the gamut in the plate at the top of fig. 2; and the same in the bass. Fig. 3, represents the different forms of pegs, to express the different notes, crotchet, quaver, &c., each note being placed under its respective peg. A triangular peg with a notch, being used as a signal peg for flats, sharps, time, &c. A semibreve peg *a* is incircled with two projections, and the peg continued above the projections, with a notch in the side; a minim peg *b* has one projection with the peg continued, and a notch; a crotchet *c* is straight with a notch; a quaver *d* has one projection, flat on the top, and a notch; a semiquaver *e* has two projections, flat on the top, and a notch; a demisemiquaver *f* has three projections, with the peg raised above the projections, and a notch; a flat side instead of a notch, to all the foregoing notes, represents them with a dot; an appoggiatura *g* is a peg tapering upwards, with a flat side; a rest *h* is the same, but has a notch instead of a flat side; a bar *i* is flat on both sides, and a double bar *k* is the same, with a notch in the top. The four positions of the triangular peg *l* on the space below the lines, represent

common $\frac{2}{4}$, $\frac{3}{4}$, and $\frac{6}{8}$ time ; the same peg on the first line, posited as in the drawing, expresses sharp, natural, flat, and turn ; and on the space between the lines, gives shake, turned shake, beat, and transient shake ; on the second line, gives trill, crescendo swells, decrescendo swells, and cord of third.

There are four more positions left on the space above the lines which may be used for more graces. On the bottom of the drawing is represented the first part of "God Save the King," with the corresponding notes in pegs underneath.

The rest note *h*, placed as in the plate on the upper line, indicates the semibreve rest ; and semibreve rest with a dot on the middle space, indicates the minim ; minim with a dot, the crotchet ; and crotchet with a dot on the lower raised line, indicates the quaver ; and quaver with a dot, the semiquaver ; and semiquaver with a dot, the demisemiquaver.

The staccato peg *m*, is like the quaver peg *d*, except that it has an additional notch in the top.

N^o VIII.

HYDRAULIC APPARATUS.



The Large SILVER MEDAL of the Society, was this Session presented to Mr. ROBERT THOM, of Rothesay Mills, near Glasgow, for a SELF-ACTING HYDRAULIC APPARATUS, for regulating the supply of Water to Mills. The following Communication has been received from Mr. Thom, and a Model of the Apparatus is placed in the Repository of the Society.

SIR;

Rothsay Cotton Mills,
Nov. 22nd, 1821.

ABOUT two weeks ago, I put an improved model of my hydraulic apparatus, on board a smack at Leith, belonging to the London, Leith, Edinburgh, and Glasgow Shipping Company; addressed to the Society of Arts, &c., care of William Vaughan, esq., Mincing-lane, London (freight paid). A drawing and description of the whole, is inclosed in the same box, with the model, as well as directions to the operator, who may exhibit it. In this respect, I have been somewhat particular; because the model exhibits no less than five distinct, and separate operations: that is, each figure in the drawing is a complete apparatus of itself, applicable to a different purpose, or under different circumstances, from any of the others. They are here put very close together, to save

expense in making a very large model, or a separate model for each ; and the apparatus has, therefore, a rather complicated appearance ; but when each operation is considered separately, it is very simple ; indeed, when viewed on the large scale, the simplicity of the contrivance is the first thing that strikes scientific observers.

The apparatus fig. 1 plate XIV, is more complicated than any of the others, on account of the variety of operations it has to perform ; but even this, upon a large scale, will appear simple.

This part of the apparatus, I contrived, in consequence of observing the plan, by which Edinburgh is supplied with water. The defect of the common method for that purpose struck me so forcibly there, that I instantly set to work to find a remedy. As soon as I had finished the model (the same as sent you), I showed it to Dr. Hope, Professor Leslie, and other directors, who expressed themselves much pleased with the invention, and directed their engineer to go to Rothesay, and see the operations on the large scale, and take advantage of them ; to me it appears obvious, that its adoption there would not only be of much permanent advantage ; but save an outlay of many thousand pounds at present.

The advantages derived from the adoption of these inventions *here* are many. We are relieved from all anxiety and care, respecting the waste of water, and the damage done to banks, and other grounds by its overflow ; the exact quantity of water required by the works is always sent down and no more ; two steam-engines of thirty-horse power have been superseded : the yearly saving thereby is above six hundred pounds sterling.

It may be proper here to state, that in the Spring of 1819, I sent to the Highland Society of Scotland a model, exhibiting that part of the present apparatus, which is shown in figures

1 and 2. None of the others were shown; indeed some of them were not then invented, and others were not *proved*.

On the other side, are directions for unpacking the model; and I will be much obliged by some careful and experienced person being appointed to do this, as well as to show the operations; the model has not only cost a good deal of trouble and expense; but will amply repay any one's trouble who has a taste for these matters. When it left this place, it performed every operation with great accuracy.

I had intended being in London about this time myself, but one of our factories being destroyed by fire, about two weeks ago, will prevent me for the present. I will, therefore, feel much obliged by your informing me if the model has come safe to hand, and if you get it to operate satisfactorily.

I am, Sir,

&c. &c. &c.

ROBERT THOM.

Explanation of the Engravings of Mr. THOM's Apparatus.—
Plates XII, XIII, XIV.

The Lever Sluice, fig. 1.—Plate XII.

This sluice, when placed on a reservoir that supplies any canal, mill, or other work with water (where the aqueduct between the reservoir and such work is on a level) will always open of its own accord, and let down the quantity of water wanted by such work and no more; that is, when water is wanted it will open, and when not wanted it will shut; so that it not only supersedes the water-man, but saves a great deal of water.

A B, a tunnel through which the water passes from the dam to

C D, the aqueduct that carries the water to the mills.

E, a float that rises and falls with the water in the aqueduct.

F, an aperture in the mouth of the tunnel.

G, the self-acting sluice that opens and shuts aperture F.

H I, a lever which turns upon fulcrum K, and is connected at one end with sluice G, and at the other with float E.

The sluice G is here represented open, as when the mills are going, but when the sluice is shut that lets the water on the mill wheel, the water in the aqueduct rises and with it float E, which raises the end I and lowers the end H of the lever H I, and shuts sluice G. When the water is again let upon the wheel, the surface of the aqueduct falls, and with it the float, which opens sluice G as before.

Upon the lever H I there is another small lever L M, which turns upon fulcrum M and has the weight N suspended to the other end L. In the ordinary working of the apparatus this lever is quite stationary and produces no effect whatever; but during floods, the aqueduct is swelled by streams that run into it *between the reservoir and the mills*, and when this happens when the mills are not at work, the water, by pressing up one end of the lever when the other cannot get down, would strain or break the apparatus. But, in such cases, the extra pressure raises the small lever which takes all strain off the other parts; that is, the weight M requires more force to lift it than is required to shut the sluice; and therefore will not move till that takes place: but when the extra strain is continued after the sluice is shut, the lever and weight then rise with the float.

The dimensions of the float are nineteen feet square by seven inches deep; the lever is twenty-seven feet long, being

twice the length between the fulcrum and the sluice, that it is between the fulcrum and the float. The sluice is three feet three inches long and fifteen inches deep ; but it requires to be raised only seven inches (when the water in front is three feet high) to pass as much water as gives a power of forty horses to a water wheel, the fall there being twenty feet.

To determine the proper dimensions of the float and relative lengths of the ends of the lever, it was necessary to ascertain how far the sluice required to be raised to pass the quantity of water wanted ; and also how far the water in the aqueduct might be raised above the height required to supply the works ; the first was found to be seven inches, and the last only four inches. The end of the lever connected with the float was made, therefore, only half the length of the end connected with the sluice ; and the float was made of such dimensions that, when sunk half an inch in water, the weight of water thereby displaced was equal to twice the weight required to shut the sluice with an equal lever. When, therefore, the water in the aqueduct rises upon the float half an inch higher than it sinks by its own weight, the sluice begins to move ; and by the time the water rises other three and a half inches, the sluice is of course seven inches down, or shut. This apparatus has now been working at Rothesay five years.

The Waster Sluice, fig. 2.—Plate XII.

This sluice, when placed upon any river, canal, reservoir or collection of water, prevents the water within from rising above the height we choose to assign to it ; for whenever it rises to that height, the sluice opens and passes the extra water ; and whenever that extra water is passed, it shuts again ; so that whilst it saves the banks at all times from

damage by overflow, it never wastes any water we wish to retain.

A B part of a canal, river, stream, or collection of water.

C D high water mark, or the greatest height to which the water is allowed to rise.

E F a sluice, or folding dam, which turns on pivots at F.

G a hollow cylinder, having a small aperture in its bottom, from which proceeds the pipe H I.

K another cylinder, water proof, that moves up and down within the former cylinder.

L a pulley, over which passes a chain attached to the sluice and to the cylinder K.

When the water in the canal or river rises to the line C D, it passes into cylinder G at the small holes M M, and this lessens the weight of cylinder K so much that the pressure of the water in front of sluice E F throws it open. When the water subsides and no longer runs in at the small holes in cylinder G, that cylinder is emptied by the small pipe H I at its bottom, which is always open, and then the weight of cylinder K shuts the sluice as before.

An apparatus of this kind was first erected at Rothesay in 1817. The dimensions of one of these are :

K, two feet diameter and two feet deep, over all : weight 500 *lbs.*

G, five feet ten inches deep and two feet one inch diameter inside.

E F,* four feet long and two feet deep, but the cylinders are powerful enough to work the sluice six inches deeper.

This sluice may be made with pivots to turn at the top, bottom, or middle : it may also be placed at the surface or bottom of the water, or any intermediate space, or right below, as suits the particular case ; the cylinders may also be placed as shown in fig. 3 without the reservoir ; that is, on the outside, or behind the dam or embankment, by having a pipe

NN to communicate between the upper part of the canal or reservoir and the cylinder. In this case, the chain passes over two pulleys and is attached to an arm projecting from the back of the sluice.

By adopting this principle, a self-acting dam may be raised in any river or stream, up to high-water mark, by which means a considerable reservoir will be obtained, whilst during floods the dam will fold down, and no new ground be overflowed.

In lawns or pleasure grounds through which streams or rivulets flow, these sluices might be applied to advantage; for, by placing one on the bank of each pond, the water within would always be kept at the same height, whether the weather be wet or dry; and, therefore, flowers and shrubs might be planted close to the water's edge, or in it, as best suits their respective habits, and their position with regard to water would always be the same.

The Double Valve Sluice, fig. 4.—Plate XII.

This sluice answers the same end as the lever sluice, but is more applicable in cases where the reservoir is deep and the embankment consequently large. It also answers the purpose of the waster sluice, as it opens and passes the extra water, whenever it rises in the reservoir the least above the height assigned, and of course supersedes a bye-waste.

In making hydraulic experiments, this sluice will also be found of considerable importance, as, by keeping the cistern from which we draw the water for the experiments always exactly at the same height, it will not only save intricate calculations, but make the result on the whole more correct.

A, part of the tunnel through which the water flows from

the reservoir to BC the aqueduct that conveys the water to the mills. DE a sluice that turns upon pivots at D. FG a hollow cylinder; H another cylinder, water proof, of rather less specific gravity than water, and which moves up and down freely in cylinder FG: a chain, one end of which is fixed to an arm attached to sluice DE and the other to cylinder H, passes over pulleys I and K; L a cistern always full of water being supplied by a spring, GM a pipe that communicates between cistern L and cylinder FG; NO the required level of the water in aqueduct BC; P a float which rises and falls with the water in aqueduct BC: attached to this float, is a spindle carrying two valves, which by the descent of the float close the aperture in the lower end of pipe M, and open the communication between M and the cistern L. When the float P, and consequently the attached valves, rise, indicating a sufficiency of water in BC, the water escapes from the cylinder FG, because the lower aperture in M is opened and the upper which communicates immediately with the cistern L is closed; as shown on a larger scale, fig. 1 plate XIII.

The sluice DE, fig. 4 plate XII, is represented shut, cylinder FG empty, cylinder H at the bottom of FG, and the water in the aqueduct at its greatest height. Suppose now, water to be drawn from the aqueduct for any purpose, the float P will fall with the water, and with it the valves. The water now flowing into FG from L will be retained; H will be deprived of its weight and consequently of its action on sluice DE, which will then yield to the pressure of the water in the reservoir and pass the requisite quantity, till the float, P rising to its former level, opens the lower valve and shuts off the communication between L and M; the cylinder FG then empties itself, and the weight H closes the sluice.

In order to make this sluice operate also as a waster sluice,

a tube is made to communicate between the reservoir and cylinder FG; this tube which must necessarily supply water to FG faster than it can escape by the valve in the lower end of M, enters the reservoir at the height to which we wish to limit the rise of the water, and whenever it rises so as to flow into this tube, the cylinder FG is filled and the sluice DE opens, and passes the extra water so long as the supply continues through the tube to the cylinder FG; when that ceases by the subsiding of the water in the reservoir to its limited height, the sluice DE shuts as before.

The axis of motion of this sluice instead of being placed at the top, may be placed a little above its centre of pressure as shown in fig. 2, plate XIII. In this case, the whole of the operations before described will be reversed; the weight of cylinder H will tend to open the sluice, and the pressure of water in the reservoir to shut it; the rise of the float P, instead of opening the lower aperture of M, will close it and open the communication with the cistern L, as shown in fig. 3 Plate XIII, the consequence will be, that the cylinder H will be deprived of its weight, and the sluice will be closed by the pressure of the water in the reservoir.

In this case, the axis of motion is placed just so far above its centre of pressure as to allow the extra pressure below to overcome the friction, and shut the sluice when cylinder H is floated: this cylinder need only be heavy enough to overcome twice the friction, in order to open the sluice when the water is drawn from cylinder FG; I have found the friction in this case to be less than one-fiftieth of the weight of the column of water pressing upon the sluice; but to guard against contingencies, the machine is made powerful enough to act, although the friction were to become one-tenth, which from the nature of things is more than it can ever be. An apparatus on this

construction was erected at Rothesay, in 1819, and has been in constant use ever since.

The Single Valve Sluice, fig. 4.—Plate XIII.

The construction of this sluice is nearly the same as the last, only it is applicable in cases where the reservoir is on high grounds above the works requiring the water; and where, of course, the water passes down a declivity.

AB part of the tunnel of a reservoir; CD a sluice that turns upon pivots at C; EF the rivulet that carries the water from the reservoir down to GH, part of a level canal or aqueduct. I is a hollow cylinder; K another cylinder water proof, of rather less specific gravity than water, which moves freely up and down within cylinder I; L a pulley over which passes a chain attached at one end to the sluice and at the other to cylinder K; M a small cistern kept always full of water, either by a small hole below the sluice or by the waste from the sluice; a small pipe communicates between this cistern and the upper part of cylinder I; NO another small pipe, communicating under ground between cylinder I and a valve at the lower end of O, which is closed by the descent of the float P; the float is placed within a small pool of water on the same level as, and communicating with the canal.

The water in the canal is represented as at its greatest height, the valve opened by the float P, the cylinder I empty because the valve at O passes the water faster than it is supplied from the cistern M; the cylinder K is consequently at the bottom of I, and the sluice is closed. When the surface of the water falls in the canal, the float P falls with it, the

valve at O is closed, the cylinder I is filled, and K floated, the sluice CD opens by the pressure in the reservoir, and supplies water till the canal GH acquires its proper height.

The mode of producing this effect may be varied as in the last instance, by hanging the sluice on pivots a little above the centre of pressure, so that it shall be kept closed by the weight of the water in the reservoir, and opened by the descent of cylinder K; the valve at O will then require to be shut by the ascent of the float P.

It is of no consequence, therefore, in regard to regulating the supply of water, how far the reservoir is from, or how high above the level of the works requiring the water; save that the length of the pipe NO must correspond with the distance, and its strength with the height or pressure of the water; it is necessary, however, that the bore of this pipe should be small, particularly where its length is considerable, in order that the sluice may open or shut in a short time after the valve at O opens or shuts, and at the same time require only a small supply of water for cistern M, as that supply must always flow, whether it be otherwise needed or not. Suppose, therefore, the opening into pipe NO from I to be only half an inch bore, and that the valve at O is shut, it is evident when that pipe is empty, that the sluice CD will not open (or shut if being on pivots placed just above the centre of pressure), till both the pipe NO and cylinder I be filled; and that the smaller the bore of that pipe, the sooner will it be filled. The time, therefore, that sluice CD takes to open (or shut as the case may be) after the valve at O shuts, will always be the same that the pipe NO and cylinder I take to fill; and to make sluice CD take an equal time to shut (or open as the case may be) after the valve at O opens, the aperture of that valve must be such as to take an equal length of time to run off the water, to the bottom of cylinder I (while the water is still flowing from cistern M),

as the pipe from cistern M takes to fill both cylinder I and pipe NO when the valve at O is shut.

The Chain Sluice.

This apparatus answers exactly the same purpose as the last, but the construction is somewhat different; that difference is described by dotted lines in connexion with the last figure, of which let all the parts be supposed to remain except the pipe from the cistern M, the pipe NO, and the float P. A pipe m communicates between cistern M and the upper end of cylinder no from the lower end of which proceeds a pipe p connected with the bottom of cylinder I; an aperture in the lower extremity of no is supplied with a valve opening downwards loaded with a weight q , and attached to a rod suspended from the end of a lever rs , moving on a fulcrum at t ; a chain passing round two pullies u and v connects the other end of this lever with a float w , of sufficient weight to overcome the loaded valve q . To apply this apparatus where the sluice is hung on pivots just above the centre of pressure, no change is required but that of making the valve q open upwards. This construction may, perhaps, be adopted with advantage on account of its cheapness, where the reservoir is very near the level canal, but a considerable height above it; as a brass wire one-tenth of an inch diameter will be strong enough for the chain where the distance is short, it having in any case little more to lift than twice its own weight; the former method using the pipe NO instead of the chain, seems better adapted to general purposes.

The Double Weather Sluice, fig. 1.—Plate XIV.

This apparatus is designed for what are generally called compensation reservoirs, where we are only allowed to retain the surplus water of floods, the rivulet or stream being allowed to flow at all other times the same as if no reservoir were there.

The usual way of doing this, which may be understood by reference to fig. 5 Plate XII. is to cut an aqueduct, AEB round the reservoir C, along which all the water of the stream is carried *past* the reservoir, except during floods, when a part runs over at the bye-wash F into the reservoir.

But before any part is thus allowed to run over, the proprietors below at Z must have all they need; and then the rise that sends part into the reservoir, sends also, more down the aqueduct; this additional part sent down is therefore lost. But the same rains that swell the streams above the reservoir, also swell the streams GHI and K between the reservoir and place below at Z, where the greatest quantity of water may be needed; all this additional water from the streams below, is therefore also lost. By adopting this apparatus all that waste is saved, or retained in the reservoir; so that whilst the proprietors below have, in all ordinary times, the same water as if no reservoir had been made, we retain in the reservoir, during floods, all the water not then needed below.

A Plate 14, a basin of water, behind a reservoir, in which the water is always kept at the same level by the apparatus, fig. 4. plate XII.

B one of a number of sluices of the same kind on that basin.

C a can, open at the top, and having a very small aperture

bottom, a chain passes over pulley D, having one end fixed to the arm E, attached to sluice B, and the other to can C.

F a weight that keeps the sluice B always shut, when the can C is empty : when that can is full of water it lifts the weight F and opens the sluice.

GH a section of that part of the rivulet immediately before it falls into the reservoir.

IKL a pipe, which communicates between the rivulet at GH and the can C.

When the water in the rivulet GH is so low as only to flow through aperture 1, then, all that water passing down pipe IKL, flows out at M into can C, which being thus filled with water, opens sluice B and passes as much water as the rivulet then brings into the reservoir. But when the rivulet swells so as to flow out at aperture 2, then, the opening at M not being able to pass the whole, the water rises in pipe IK, and passes along pipe NOP, and falling into another can,* opens a second sluice, which, with the first, passes as much water as the rivulet then brings into the reservoir. When the water in the rivulet rises so as to flow out at aperture 3, it rises also in IK, and passing along pipe QRS, flows out at S into a third can, and opens a third sluice; and these three pass as much water as the rivulet then brings, and which is here supposed to be the greatest quantity wanted at the place Z, fig. 5 Plate XII. Suppose now, the flood should still continue to increase; then the streams and surface water between the reservoir and Z, will increase the rivulet at Z, as well as the higher streams increase it at GH; but there was previously enough of water at Z; when, therefore, the rivulet rises so as to flow out at aperture 4, the water will

* The first can only is shown in the engraving, but the relative situations of the other cans with respect to the pipes P and S, may be easily understood.

rise also in the vertical tubes NS, PT, RU, MP and S, which are respectively surmounted with wide hollow cylinders TU and V, containing the water-pipe floats WX and Y. The water first rises to float W, which it lifts and thereby shuts valve L; the water in can C then passes out at the small opening in its bottom, and the weight P shuts sluice B, which stops as much water in the reservoir as the streams below have increased. When the water rises in the rivulet so as to flow out at aperture 5, it rises also in the tubes till it lift float X, which shuts another sluice. When the rivulet rises till the water flows out at aperture 6, it raises float Y, and shuts the third or last sluice, the flood being now supposed so great that the streams below the reservoir are sufficient for the supply at Z. When the streams begin to fall, the rivulet at GH will also fall, and when the water ceases to flow into aperture 6, the water falls so far in the tubes as to let down float Y and open one sluice; when it ceases to flow out at aperture 5, the float X falls, and a second sluice opens; when it ceases to flow out at aperture 4, the third sluice opens; which, with the other two, passes all the water that the rivulet is then bringing into the reservoir. Should the rivulet continue to fall so as not to flow out at aperture 3, then the water ceases to flow along QR, and one sluice shuts; should it fall below aperture 2, the water also ceases to flow along NO, and a second sluice shuts; should the rivulet become quite dry, then the third or last sluice shuts. Any number of sluices may be used as found necessary: and in this way the same quantity of water will always run in the rivulet at Z as if no reservoir had been placed in the rivulet above; except during floods, when all the water not needed at Z, would be retained in that reservoir. Besides the immense quantity of water thus gained during floods, the expense of cutting an aqueduct round the reservoir is also saved,

nor is any bye-wash necessary, as the main sluice on the reservoir that regulates the height of the water in the basin A, acts also as a waster sluice when necessary. When it is necessary to supply any fixed quantity of water from the reservoir, we have only to make an aperture in the basin of the proper size, and, as the water there stands always at the same height, the supply will always be the same.

The Single Weather Sluice, fig. 2, Plate XIV.

ONE of the applications of this apparatus is, to give, at all times, an equal supply of water to any work, situated like Z, in the last case, where the reservoir is at a great distance from the work, and where it might be inconvenient or expensive to lay a pipe between them as in fig. 4, plate XIII.

The description of the last figure applies also to this, only when the can C is filled with water, it shuts sluice BC, instead of opening it as in that figure.

In very dry weather, when all the streams between the reservoir and the work are dried up, then it requires all the sluices at the reservoir to be open to give the necessary supply to the works, but when the streams begin to flow a little, one sluice at the reservoir shuts, by the water flowing through aperture 1 into can C; when they increase still further, the water flows out at aperture 2 and along pipe NO, and shuts a second sluice; should they still increase till the water flow out at aperture 3, the third or last sluice shuts, the streams of themselves being now equal to the supply required. As the streams again fall off, the sluices will open, one after another, so as to keep the supply of water at the work always equal.

It is necessary, in this case, to have a small reservoir near the work to contain the water that flows down at night, or when the work is standing ; and then this apparatus will be a complete substitute for the last apparatus, fig. I, plate 14. The purpose, however, for which this apparatus was invented was different. Having occasion to cut an aqueduct round the bases of some hills, to collect water and convey it to a reservoir at a considerable distance, I found that to make the aqueduct so large as to convey all the water during floods would be too expensive ; it therefore occurred to me, that if a part of the water could be detained during floods, and brought away gradually afterwards, a much smaller (and of course much less expensive) aqueduct would answer the purpose ; I therefore made a small reservoir, at a convenient place, and contrived this sluice to shut during floods and to open as they decreased ; and this answered the purpose intended completely, and was the origin of all the weather-sluiques.

N° IX.

HYDRAULIC ORRERY.

The GOLD VULCAN MEDAL was this Session given to MR. C. A. BUSBY, of London-street, Fitzroy-square, for a HYDRAULIC ORRERY. The following Communication has been received from the Candidate on the subject, and a Model of the Apparatus has been placed in the Repository of the Society.

SIR ;

18, London-street, Fitzroy-square,
March 1st, 1822.

I TAKE the liberty to trouble you with a small elementary model of an invention of mine, the Hydraulic Orrery, which has met the particular approbation of some of our leading philosophical characters ; and which I will trouble you to lay before the Society of which you are secretary.

The larger, and far more perfect machine, is not of a nature to be conveniently moved, or I would have sent it in preference ; but, if the members of the Society will do me the favour to inspect it in action at my office, I shall feel myself particularly honoured by the opportunity they will thereby afford me of explaining its motive principles.

I am, Sir,

A. Aikin, Esq.

&c. &c.

Sec. &c. &c.

C. A. BUSBY.

*Explanation of the Motive Principle of the HYDRAULIC
ORRERY.*

London, May 1822.

ABOUT three years ago I was engaged, during my stay at New-York, in a course of experiments to determine the resistance opposed to solid bodies of various forms, in their passage through fluids. To perform these in the most simple and effectual manner, I provided a large bason or circular reservoir, and placed therein near the circumference, any floating vessel that happened to be the subject of trial. This vessel was connected by an arbor to a floating centre, held in its place by a small shaft passing through it, and erected perpendicularly from the bottom of the reservoir. The bottom of the floating vessel was pierced, and a syphon which it carried, being soldered into the aperture, rose from it, and extending over the circumference of the reservoir, its other extremity depended in air at a lower level than the surface of the water. This outer leg of the syphon was closed at the bottom; but a minute lateral aperture, resembling a very small finger-hole of a flute, being made, the water spouted through it (when the syphon was charged) in a direction parallel to the vessel, which instantly began to move with accelerated velocity in an opposite course. In a few seconds a maximum was attained, and the future progress exhibited that beautiful, continuous movement which can only find an adequate comparison in the silent gliding of the heavenly spheres. The idea instantaneously impressed me, and has been subsequently embodied, with the most encouraging success, in the novel machine above-mentioned.

At present I have applied the principle, under appropriate modifications, no farther than to the Sun, the Earth, and the

Moon, whose circuits, obliquities, parallelisms, and rotations, are displayed in apparently spontaneous movements on an area of five feet diameter. To effect these, three floating syphons are so combined in succession, that a quantity of water equal to the discharge of a single stream about one-eighth of an inch diameter, with a head of about seven inches, elicits every action. Each motion, as in nature, is perfectly independent; any one may be checked without impeding another; and when the hydraulic orrery commences its operations, it practically illustrates those incipient and gradually accelerating movements, which may be supposed to have taken place within the mighty system itself, when, as in the beginning, the maximums of the greater motions were probably attained in succession.

This motive principle (founded on Barker's mill, but now first combined with a syphon, and applied to a floating body) is applicable to an extensive variety of experimental and philosophical purposes. It is so truly equable, that by means of it I make the novel and interesting experiment of producing a perfect hydroparabolic mirror fifty-four inches diameter, and thus create any magnifying power *ad libitum*. Whirling tables upon this principle will preserve any particular velocity, during any required period of time, and the motion permits the most minute regulation, either by a variation in the length of the syphon, or of the size of the discharging aperture; or by so fixing a small flexible inclined plane to the syphon itself, and bending it into the stream, as that any proportion of its re-action may be neutralized by its action.

Another mean of obtaining an universal standard of measure is hereby provided independently of the pendulum. Thus a given parabolic speculum, will invariably be formed by any given rotation at any known level and latitude, and the focal distance of any parabola must under those circumstances be

always a given dimension. A graduated revolving circle will also practically measure such minute portions of time as are beyond the recognition of the most accurate astronomical clocks. The hydraulic orrery when in action lowers the surface of the water upon which it floats, about one inch in an hour; it is effectually stopped by blowing air into the syphons, or by preventing the efflux of water in any other manner.

Construction of the Hydraulic Orrery.

THE Engraving, plate XV, contains the plan and section of the apparatus; the same letters are used to point out the corresponding parts of the figures 1 and 2.

There must first be imagined a circular reservoir 5 feet diameter, of which it is the centre, and B B parts of the circumference; C C is a circular gutter (11 inches internal, and 9 inches external diameter) floating concentrically in the reservoir; D is a bar fixed diametrically across the bottom of the inner circle formed by the gutter C C, from the middle of this bar a small shaft E is erected; F F is a cylindrical floating vessel $8\frac{1}{2}$ inches diameter, a tube is soldered into an opening (one inch diameter) in the centre, the top of this tube is closed, except a small hole through which the shaft E passes, and acts as a pivot; a cap covers the central tube and terminates in a rod surmounted by a ball (9 inches diameter) representing the Sun; G is a syphon soldered into an aperture in the floating cylinder F F and balanced by a weight on the opposite side; the other leg of this syphon hangs over into the circular gutter C C, into which it discharges a minute *lateral* stream of water, the re-action of which stream gives a rotatory motion to the vessel F F, and consequently to

the ball which it carries. The water discharged into the gutter C C, passes away through the tube H, beneath the surface of the great reservoir, and enters the floating cylindrical chamber I I; this chamber is 8 inches diameter, is surrounded by a second cylinder K K 11 inches diameter, but the water of the great reservoir is admitted through large apertures beneath, into the intervening space.

In the centre of the chamber I I, a tube one inch diameter is erected, closed above and below, except small central openings through which the shaft L passes, ultimately bearing a 3 inch ball representing the Earth. In the circular space between the cylinders I I and K K, floats a ring M M, a bar extends diametrically across the upper part of this floating ring, and the shaft L acts as its pivot through a central opening. Upon this ring is erected a small shaft bearing a $\frac{3}{4}$ inch ball representing the Moon.

On an opposite part of the ring, one leg of a syphon is soldered into an aperture, while the other leg hangs over into the chamber I I, into the lower part of which it discharges a small stream *laterally*; the re-active force of this stream causes the ring to revolve, and, consequently, to carry the ball representing the Moon round that by which the Earth is designated.

The water now brought into the chamber I I, by the two syphons which move the balls representing the Sun and Moon, is carried away by a great syphon O, communicating with it by a short horizontal tube; this water is discharged *laterally* at a lower level from the great syphon into an external gutter P placed to receive it, and its re-active impulse gives motion to the whole apparatus, and causes it to perform a circuit in the great reservoir representing the annual orbits of the Moon and Earth about the Sun.

The parallelism of the Earth's axis is effected, by fixing a

circular plate (6 inches diameter) to the lower extremity of the rod L, and connecting its circumference by three equal oblique rods 1, 2, 3, with that of another circular plate fixed to the center of the bottom of the reservoir; thus is formed a sort of circular parallel rule, which produces the desired effect; the lateral confinement of the central part of the apparatus being effected by means of the inclined forked brace 4, shaped like a spur, and clasping the fixed plate, itself being fixed to the inner extremity of the tube H upon a hinge incapable of lateral action.

The longer arm of the steel-yard Q (attached to the shaft L and moveable on a vertical joint) sustains the lower extremity of a slender rod connected by an universal joint R with the axis of the 3 inch globe, a small wheel is fixed upon this rod towards the lower end, and the conical rim S S, borne by and revolving with the circular shaft which carries the Moon, acts upon the little wheel by contact with the edge, gives it a rotatory motion, communicated immediately through the universal joint to the globe above, while the shorter arm of the steel-yard is balanced by a weight just sufficient to keep the wheel slightly pressed against the rim.

The obliquity of the Moon's path is imitated, by causing the auxiliary rod sustaining the smallest ball to slide up and down through two projections from the main standard as she revolves; this is effected by making a joint at V and attaching the lower extremity to a revolving crank W, this crank is fixed to the continued axle of a thin vertical wheel X rolling on the horizontal circle Y, which is itself fixed to, and borne by, the shaft supporting the Earth.

The change of the Moon's nodes is performed by making a due variation between the diameter of the vertical wheel and that of the circle upon which it rolls. The four balancers

(5, 6, 7, 8,) are added, for the purpose of keeping the apparatus steady, by a necessary extension of the floating base.

C. A. BUSBY.

P.S. I beg to add the following testimonial with which I have been honoured, by some of our leading scientific characters.

CERTIFICATE.

London, January, 1822.

HAVING seen the Hydraulic Orrery, invented by Mr. C. A. Busby, in action, we feel much pleasure in testifying our decided approval of the apparatus, as exhibiting a novel, ingenious, and elegant application of hydraulic force.

CHARLES HUTTON.

OLINTHUS GREGORY.

EDWARD TROUGHTON.

P. KELLY.

TIMOTHY BRAMAH.

FRANCIS BRAMAH.

N^o X.

IMPROVED HAMMER FOR TURRET CLOCKS.



The sum of TWENTY GUINEAS was this Session presented to Mr. W. WYNN, of Dean Street, Soho, for an IMPROVED HAMMER FOR TURRET CLOCKS. The following Communication has been received from Mr. WYNN, and a Model of his Invention has been placed in the Repository of the Society.

SIR;

Dean Street, Soho,
April 10, 1822.

I HEREWITH send you a Model and Description of improvements which I have made in the principles of turret clocks, which I request you will have the goodness to lay before the Society for the Encouragement of Arts, &c. &c.

I am, Sir,

A. Aikin, Esq.

&c. &c. &c.

Sec., &c. &c.

WILLIAM WYNN.

Dean Street, Soho, London.

The great expense attending the manufacture of turret clocks, is occasioned by the magnitude of the machinery which is necessarily employed in raising a ponderous hammer, which shall strike with sufficient force on a large

bell to produce a sound capable of being heard at a distance from the clock, so as to be useful to the surrounding neighbourhood. It cannot fail to be evident to every one acquainted with the subject, or to any mechanical gentleman who would take the trouble to examine the hammer-work of turret clocks, that a great portion of the force of the percussion of the hammer is lost before it comes in contact with the bell, and, consequently, a great deal of power is exerted in vain, in lifting them. The counter-spring of the hammer (a spring which supports the hammer from resting on the bell) opposes considerably greater resistance to the blow than the actual weight of the hammer, because it has the power of supporting it much above that part of the bell on which it strikes. The friction that takes place between the counter-spring and the hammer is very great, in consequence of the rust which it unavoidably contracts by its necessary exposure to the open air; and I think I should not overrate both these resistances, if I estimated them at equal to twice the weight of the hammer. Having been so fortunate as to obtain the sanction and approbation of the Society of Arts, for a timekeeper which I submitted to them a short time since, I have been encouraged to make a second attempt to obtain their patronage, by presenting them with the model of a hammer for a turret clock, wherein I have succeeded in annihilating both the above resistances, and have made such other improvements in raising the hammer, preserving its pivots from rust, and unlocking the striking part, as I trust will be found of importance to the manufacture of turret clocks, as it regards a reduction in their original expense, by lessening the maintaining power, and consequently, the magnitude of the work, preventing the necessity of subsequent repairs,

and causing a greater degree of accuracy and certainty of performance.

I have constructed a hammer without a counter-spring, which has the advantage of falling with the whole force of the percussion on the bell without any resistance, and of being caught up at one-fourth of the height from which it fell by the re-action of the blow ; consequently, releasing the power of the striking train from the exertion of lifting the hammer equal to that quantity. A hammer on this principle will, therefore, strike a bell with far greater force than one on the usual construction, and it will also oppose but three-fourths of the resistance by its draught on the striking train. On the axis of my hammer is a ratchet, and a click is made to act in it, which has a spring like the hammer-spring of a gun lock, which will force the click both against the ratchet and, by a small change of position, away from it. There is a lever on the ratchet which goes under the click, and which forces the click away from the ratchet when the hammer is raised to strike the blow, and, consequently, gives liberty for the hammer to fall ; but, just before it strikes the blow the lever comes in contact with another lever attached to the click, and brings it again in contact with the ratchet, ready to catch the hammer at any height to which it may rebound.

Much friction is occasioned by the pivots of the hammer becoming rusty from their exposure to the atmosphere, which causes a considerable resistance to its draught, and which I have found means to prevent by putting a brass collar over the pivot, so as to form a sort of cup or receptacle for oil, which collar enters freely into a groove in the collet in which the pivot-hole is made. By filling with oil the pivot-hole, which is closed air tight at the end on the outside, the oil will flow over into the cup, where it will be

retained by the pressure of the atmosphere and by attraction of cohesion, and will completely exclude all moisture from the pivot, which by this means will be prevented from becoming rusty, and will very much reduce the resistance both in the rising and the falling of the hammer.

By the application of a hammer thus constructed, I shall derive a great advantage from the accelerated force of falling bodies, which could not be done where a counter-spring is made use of; for if a hammer had too much fall given it, the counter-spring would not have a sufficient command of it to prevent it from chattering the bell. By the shortness of the draught of the hammers now in use, the accelerated force of the percussion is not taken advantage of; for a hammer of a given weight which falls from a height of eight inches, will fall with four times the force of one from four inches, and cause but twice the resistance; and one falling from twelve inches will fall with nine times the force of the first, and only increase the resistance to three times the quantity. In a hammer constructed on the principle I now produce, there will be no objection whatever to a long draught; on the contrary, it will rebound with more force by falling from a great height than from a lesser one, and thus obtain the advantage of the accelerated force of falling bodies. In the large turret clock at the Royal Military College which I have the management of, there is a hammer that weighs fourteen or sixteen pounds, which does not fall from a greater height than two and a half or three inches. If this hammer were reduced to one third of its present weight, and its perpendicular action increased in a three-fold proportion, the resistance to the train would be the same as it now is, and the addition acquired in the force of its percussion by the accelerated force, would be three times as

great, without taking into consideration the loss of that resistance which the counter-spring opposes; consequently, the bell would be heard with greater effect in its immediate vicinity, and the utility of the clock would be extended to a far more distant circuit.

I have also found a great resistance in the common mode of lifting the hammer by a hammer tail, both from the great length of space which the pin has to pass along the hammer tail, and the difficulty of making the oil remain on a straight long surface, and that, in an inclined position, subject to continual jerks by the falling of the hammer; so much so, that when I have found the striking part of turret clocks stopping by the cold inclement season, I have made them go by fresh oiling the hammer tail only; a proof that the resistance of that part of the clock has considerable influence on its performance. I have succeeded in lessening this friction, by the application of a compound-toothed sector on the pin wheel of the striking train instead of pins, which acts in a simple-toothed sector instead of a hammer tail, and which reduces the friction in the proportion of twice the versed sines of twelve angles of $3^{\circ} 45'$, and twice the versed sines of 45° , I have made the compound-toothed sector by cutting a wheel of 96 teeth, and filing out six teeth and leaving six, alternately all round the wheel, and the simple-toothed sector of the same radius as the wheel with six teeth, instead of a hammer tail to act in it; so that when the teeth of each branch of the compound-sector have passed through the simple one, it lets it fall in the same way as the pin would let the hammer tail fall. Besides lessening the quantity of friction, the resistance to the train will be equal in all positions of the leverage, and the oil will adhere far more tenaciously to

teeth than to a plane surface, and it must be the means of preventing the mis-performance of the clock by the inclemency of weather, a thing which often occurs, and which is attended with much inconvenience, particularly where a workman is not at hand to remedy the defect.

The same principle is applicable to the lever of the unlocking detent, to relieve the watch part from a great portion of friction in unlocking the striking part. In the model I now produce, I have made a pinion of twelve with two of its leaves filed out, which represents the axis of the motion wheel which revolves by the power of the watch part once in an hour. This pinion, or rather toothed sector, as it revolves, gathers up a toothed sector with ten teeth of a circle of 144 teeth, whose radius is as twelve to one of that of the pinion; and when that part of the pinion which has lost its teeth comes round towards the axis of the sector it will of course let the lever fall, and the striking part will be released. On the scale which I have made the model, I produce 1·3 inch of motion at the end of the lever; to accomplish this quantity of motion by the spiral curved plate (the best method now in use), the smallest radius of which, is ·5 inch, and the largest one of 1·8 inch, there will be a plane of $7\frac{1}{2}$ inches pass under the lever; but to produce the same quantity with toothed sectors of the proportion of twelve to one, the length of whose legs are 2·7 inches, and ·225 inch, the friction will be only as the versed sines of ten angles of $2^{\circ} 30'$, and the versed sines of ten angles of 30° , which compared with $7\frac{1}{2}$ inches, gives the relative proportion of the friction of the toothed sectors and the spiral curve. Beside so materially reducing the friction, I produce the necessary quantity of motion by a lever, viz., the pinion, at only ·225 inch from the center of motion, instead of its

acting at from $\cdot 5$ inch to $1\cdot 8$ inch from the center, which it would do if the spiral plate were used, which of course lessens the resistance on the watch part in the proportion of those numbers.

The sound produced on a bell by the new-constructed hammer, will be perfectly pleasant, as there will be no possibility of the hammer's chattering on it. All turret clocks are susceptible of being altered, and all or either of the new principles may be applied to any which are now made. In such clocks as are in the habit of stopping in cold weather, the application of the toothed sectors would be the means of preventing that inconvenience, and in those where it might be desirable to extend their utility by increasing the sound of the bell, the application of the new hammer would attain that object in a high degree. By the application of all the new principles in the manufacture of turret clocks, the weight of the hammer will be so lessened, and the friction of drawing it so reduced, that comparatively small machinery will lift them, and that too, with more certainty and accuracy than the large machinery will lift the hammers now in use, because the diminution of the general dimensions of the work will lessen the friction in all its parts, and the expense of the manufacture will be lessened very materially thereby. Any number of hammers may be raised by the toothed sectors.

The principles are applicable to the construction of common house-clocks, and would be a great improvement to them, without materially increasing the expense of their manufacture. In fact, all the levers of the repeating work might be put in motion by the toothed sector, which, as it would reduce the friction, would cause a greater certainty of performance, increase the durability,

prevent the necessity of repairs and cause the clock to keep time more correctly.

WILLIAM WYNN.

Reference to the Engraving of Mr. WYNN's Striking part of a Turret Clock.—Plate XVI.

Fig. 1 a front view.

Fig. 2 a side view.

a a a the frame containing the hammer work.

b b part of the striking part (the frame plate in fig. 1 being removed).

c the axis of the hammer having a ratchet or toothed segment attached to it.

d a click, which acts in the ratchet.

e (the dotted line) a heart-shaped wheel of brass, fixed on the same axis as the click.

f a spring fixed by a screw at its lower extremity, and terminating at the upper in a roller, which keeps up a constant pressure on the projecting point of the heart-shaped wheel; and thus acts on the click so as to retain it between the teeth of the ratchet, or to hold it up out of contact with them according to the position of the wheel.

g a pin fixed in the ratchet, which comes in contact with the inclined plane of the click as the hammer is drawn up, and throws the click up out of the teeth of the ratchet before the hammer arrives at its greatest elevation; at the same time, the heart-shaped wheel *e* having passed the roller at the head of the spring holds up the ratchet.

h another pin which comes in contact with the tail *i* of the click, just before the hammer in its fall reaches the

bell driving the heart-shaped wheel back again past the roller; and dropping the click in the ratchet so as to retain the hammer at any height to which it may rebound.

The dotted line *k* indicates the height of the hammer at its greatest elevation; and *l* the position to which it falls when in contact with the bell; and the position *m* of the hammer in the engraving shows the height to which it is thrown by the rebound.

Fig. 1 and 2, *n* the hammer head; the shank of the hammer is unavoidably drawn through the side view, fig. 2, for want of room.

E the compound-toothed sector to be applied to the pin wheel of the striking part; it has eight pins *ooo* in it for the purpose of locking it at each fall of the hammer, which is necessary in the model to make it act properly.

Fig. 1, *p* the simple-toothed sector, in a position ready to act in the compound one when a power is applied.

Fig. 1, *q* a wire which connects the model of the clock with the hammer, and draws it up when in action.

Fig. 1 and 2, *r* the pinion with two of its leaves cut out which represents the axis of the motion wheel.

s the toothed sector, which has a lever or detent fixed to its axis, which represents the lifting and locking detent of a clock, and which is raised by the motion of the pinion *r*, till it has revolved to the place where the teeth are cut out, and then lets it fall, and the striking part becomes released.

Fig. 3 a representation of the axis of the hammer at full size with the brass collars, and apparatus for preserving the pivots from rust.

t t parts of the frame plates.

u u sections of two collets fixed in the frame, with the pivot holes in the center, with a groove turned at *v v*.

ww two brass collars fixed to the axis of the hammer, which are formed as receptacles for oil, and which are turned to enter the groove *vv* without touching it.

xx two screws which close the pivot holes at the ends to keep them air tight.

The brass collet *u* is drawn out of the frame and off the pivot of the hammer at the bottom of the plate, to represent those objects more clearly.

SIR ;

Dean-street, Soho,
Aug. 17th 1822.

WHEN I had the honor to lay my last communication relative to my improved hammer for turret clocks before the Society, I was labouring under indisposition ; and it was with some difficulty, I was enabled to produce it in the state I did before the close of the session. I was consequently obliged to make my comparisons of resistance in the best manner I could by estimation, without having the means of making experiments on the subject. Having recently made an experiment on the resistance to the fall of the hammer ; I think it necessary to communicate the same to you, especially as the result has turned out far more favourably to my new hammer than I expected ; and I hope it will arrive in time to accompany my former paper in your volume about to be published, should the committee of correspondence and papers think proper.

I made the experiment on the hour hammer of the turret-clock, at the Royal Military College, which weighs 12 *lbs*. It has a perpendicular fall of $3\frac{1}{4}$ inches ; the axis of the hammer is placed above the crown of the bell, and the head of it, when at rest on the counter spring, forms an angle of about 50° below a horizontal line. I fixed a wire round the center of gravity of the hammer head with a hook below

it to suspend a weight on. I then lashed a quantity of bricks together, which I found on the roof of the building and suspended them on the wire, and I found that the pressure of ten bricks weighing 66*lbs.* 4*oz.*, did not overcome the resistance of the counter-spring, as I could just discern a space between the bell and the hammer, and the bell would sound when touched. The pressure of 66*lbs.* 4*oz.* on a lever inclined to the horizon in any angle is as the co-sine of that angle to radius, which by estimating the angle of position of the hammer when the experiment was made at 50° below the horizon, will prove the actual resistance of the counter-spring to be equal to the pressure of 42*lbs.* The whole force of percussion of a hammer of 12*lbs.*, falling perpendicularly 3¼ inches does not exceed the pressure of 50*lbs.*, and out of that force the experiment proves that 42*lbs.* is opposed by the resistance of the counter-spring, and only the force of 8*lbs.* remains to put the bell in vibration. The hammer is lifted by an eight day movement with a maintaining power of 5*cwt.* It is a clock made by one of the first makers, about ten years since, and is I think as fair an object for comparison as could be chosen; but I should feel happy to accompany any gentlemen of the committee, to make similar experiments on any hammers which might be thought proper.

After knowing the result of this experiment, it can be no longer a wonder that we hear such faint tones from most of our church clocks; for although machinery of great magnitude and heavy weights are employed in lifting the hammers, there is comparatively no force produced to put the bell in vibration. It is easy for any one to judge that the bells are not put in vibration, for none of the clocks produce that sound as is produced by ringing the same bell with a rope.

I beg to suggest also the impracticability of making a clock to go eight days and to strike on a large-sized bell, so as to produce any effect. In fact, according to the present system, it has been found that so great a maintaining power is necessary for that purpose, as will grind the great wheel teeth to dust, before an eight day piece will lift a hammer to put a large bell in vibration; and that will not be found strange to any person acquainted with the laws of mechanics, when it is considered that a hammer of 20*lb.* or 30*lb.* weight has to be lifted 1248 times at once winding up the weight. With the new hammer for which the Society has so liberally rewarded me, this is quite practicable, which will be the means of saving perpetually a great annual expense to the public, by requiring the attendance of a person only weekly, instead of daily to wind it up; and an eight day clock will perform more accurately than a thirty hour one, as it will not be disturbed so frequently by the act of winding.

Even in thirty hour clocks, where the bell is large, it is impossible to produce effect on the present system. I was walking at 150 yards distance from a church recently built, one evening within this month, in an open space, in the most favourable situation I could have placed myself when the clock struck nine; not a carriage moving, and the evening perfectly serene. I listened with the greatest attention to the striking of the clock, and there was one of the blows of the nine, which neither I nor my companion could distinguish. The bell from its sound seems to be a particularly large fine-toned tenor, but the force of the hammer is not sufficient to put it in vibration. If my new hammer was applied to this bell it would increase the sound incalculably.

I will not attempt to give a minute calculation as to the

increase of force which my new hammer is capable of producing, because the force of percussion of falling bodies as compared with the pressure of gravity, and the resistance occasioned by friction, are neither of them capable of being discovered with mathematical exactness, yet it may be approached to something near the truth. According to the accompanying experiment, it appears that by annihilating the resistance of the counter-spring the force will be increased to six times its present amount, as it will be increased from 8 to 50; which multiplied by three (the increased force produced by extending the perpendicular fall, as stated in my former communication) will produce an increase of eighteen times the force as compared with that of the hammer of the clock at the Royal Military College, and that too with only two-thirds the resistance of the draught of the hammer, the train being relieved from lifting it one-third of its draught. According to this theory, a maintaining power of one-eighteenth the weight when the new hammer is applied, will produce as much effect as is produced on the present system. If the great resistance of friction which takes place by the employment of heavy machinery, pivots of large diameter, and large ropes which are necessarily wanted to suspend the great weights on, be taken into consideration, it will be found to have been hitherto immense; and when it becomes generally known that some of these resistances are annihilated, and others materially reduced, I trust that the new plan will be generally adopted, both in the manufacture of new church or turret clocks and in those which are already in use by exchanging their old hammers for new ones.

I cannot conclude this without informing you that the method of lifting the hammer with the compound-toothed sector is very convenient for the quarter part of clocks, as

any number of hammers may be lifted with one compound-toothed sector.

I am, Sir,

A. Aikin, Esq.

&c. &c. &c.

Sec. &c. &c.

WILLIAM WYNN.

Nº XI.

REGULATING SCREW FOR THE MAIN-SPRING
OF MUSKETS, AND OTHER FIRE ARMS.

The SILVER VULCAN MEDAL was this Session given to Mr. EZEKIEL BAKER, of Whitechapel Road, for his REGULATING-SCREW FOR THE MAIN-SPRING OF MUSKETS AND OTHER FIRE ARMS. The following Communication has been received from him, and a Model of the Invention has been placed in the Repository of the Society.

SIR ;

24, Whitechapel Road,
Feb. 27th, 1822.

IN taking leave to request you will lay before the Society the accompanying model of an improvement in gun-locks, I trust the merit of the invention will induce the Society duly to appreciate its advantages ; and shall consider the labour and expense as amply compensated

by their approbation. The following explanation is necessary for clearly comprehending the advantages to be derived from its adoption.

It is well known that the main-spring of all locks loses its strength, either from wear or from the effect of climate, as also that the flints become thick from use—either of which is of itself sufficient to cause the lock to miss fire. This was, perhaps, more particularly exemplified by the volunteer regiments, on field-days, when embodied during the late war, and the fact has been corroborated by many veteran soldiers as having occurred too frequently on the field of battle.

Now, Sir, my invention will remove all this, and may be easily effected by the soldier with the common turn-screw, which it is well known he invariably carries to put in his flint, &c. It consists of a regulating screw-pin, which is placed behind the hammer, through the solid piece of the plate. This pin, when screwed down, acts upon the short side of the main-spring, by forcing which its strength is increased, and more fire is consequently drawn from the hammer; so that, in either of the instances alluded to, fire is produced when it would otherwise fail. On the other hand, when a new flint is introduced, the power of the main-spring may be lessened by turning the screw-pin backwards; by which means the flint is prevented from breaking, as frequently happens when it is put into a lock upon the present construction.

Having alluded to the more important consideration of rendering musket-locks perfect on the field of battle; the same will apply to gentlemen sportsmen, and will prevent the vexation and disappointment that too often occur from locks missing fire, when an experienced shot would otherwise make sure of bagging his game. I have for

many months experienced its advantages—and have the satisfaction of testimonials from some of the most experienced gamekeepers, whose whole lives have been devoted to the sports of the field. Those of his grace the duke of Bedford, lord Petre, and sir Thomas Lennard would of themselves be sufficient, but I have others from private individuals equally flattering to my improvement.

I should remark, that to all new locks, the invention can be applied *without any additional expense*; but to old locks, in most instances, it will be necessary to have a new main-spring, as the stud which holds it steady on the plate is usually placed on the middle of the short side of the spring; and consequently the regulating screw applied to these may chance to break itself, or break the main-spring: whereas in a new lock I place the stud on the bend of the spring, which enables it to play at pleasure without fear of injuring the one or the other. I also make the hole in the eye of the spring oblong, so as to enable it to play more easily up or down as occasion may require, than the round hole admits.

This invention may be applied with equal effect to the locks of doors, and spring bolts of every description; when, from weakness or any other cause, the springs lose their power; and the great advantage is, that my improvement may be adopted at a very trifling expense.

Having explained the simplicity with which my invention may be applied, I will not take up more of your valuable time; but shall be happy to wait on the Society at their convenience, and furnish every information which may be required for a clearer elucidation than I may be able to convey on paper.

I am, Sir,

&c. &c. &c.,

EZEKIEL BAKER.

A. Aikin, Esq.,

Sec. &c. &c.

P. S. I am well aware, that the hammer springs of saddle pistol and gun locks, have been long since made with a similar provision to the above; but, I believe, its application to the main-springs, where it is of so much more importance, has never been made by any one previous to my doing it.

Reference to the Engraving of Mr. E. BAKER's Gun-lock.—
Plate XVII.

Fig. 1 represents the inside of a lock of the usual construction, with the addition of an adjusting-screw *a*; this screw presses against the main-spring *b b*, and when driven forwards greatly increases its power, so that when a flint is getting blunt, the power of the spring may be so increased as to secure its giving fire, and when a new flint is put in, it may be preserved by releasing the main-spring so as to act with no more power than is just requisite to give fire. The hole in the tail of the spring *b* is elongated to slide under the screw head *c* when the adjusting screw *a* is moved.

N° XII.

CAISSON FOR REPAIRING SHIPS AFLOAT.

The Large SILVER MEDAL was this Session given to Mr. W. HOOKEY, Master Shipwright's Assistant, for a COFFER FOR REPAIRING SHIPS AFLOAT. The following Communication on the subject has been received from Mr. HOOKEY, and a Model of the Machine is in the Repository of the Society.

SIR;

Royal Dock-Yard, Woolwich.
March 21st, 1821.

I HAVE long had in contemplation the construction of some simple machine, for the purpose of stopping leaks, and shot holes, and for shifting a few sheets of worn copper from the bottoms of vessels, at the depth of four or five feet under water, without the trouble and expense of docking the vessel for those repairs, and without incurring the difficulties and impediments which I have frequently observed, while in the course of the war my duty called me to attend to the fitting of ships of war at Spithead. Such a machine I have now completed, and a model of it I beg to lay before the Society of Arts; from whom I have already received so many marks of approbation and attention.

If any repairs become necessary two or three feet under water, the machine may be immediately applied, and if at the depth of four or five feet, it will only be necessary to heel the vessel about two feet, and it becomes applicable at that depth.

I beg only farther to observe, that the machine may be made by any ship's carpenter on board, with any 2 inch or $2\frac{1}{2}$ inch stuff, which is at hand, and consequently at little or no expense, and it may be applied without danger, its simplicity being such that no sailor on board will be at a loss to fix it in its intended situation. Its advantage in a foreign port and open roadsted are obvious, and it will probably in many cases prevent that dangerous and laborious process of heaving down and consequently save a considerable expense.

I conceive it to be unnecessary to enter farther into any written description of this apparatus; I shall therefore, only add, that my object in laying it before the Society is, that it may be made public, and I hope useful to the merchant service and to my country.

I am, Sir,

&c. &c. &c.

A. Aikin, Esq.

Sec., &c. &c

WM. HOOKEY.

CERTIFICATES.

His Majesty's Ship *Leven*,
Woolwich, November 22nd, 1821.

THESE are to certify, that the machine of Mr. Wm. Hookey's invention, for getting at leaks in a ship's bottom under water, was applied to this ship for the purpose of

repairing the pipe which lets in water for washing the decks, and succeeded in the completest manner. We are of opinion that it is a most useful invention, and for its simplicity of construction, and facility of application highly deserving of every encouragement.

W. F. W. OWEN, *Capt. of H. M. S. Leven.*

W. CUTFIELD, *Com. of H. M. S. Barracouta.*

ALEX. H. VIDAL, *Lieut.*

WM. MUDGE, *Lieut.*

THOS. BOTELER, *Lieut.*

WM. MOORLEY, *Master.*

H. M. S. Sampson, Woolwich,
May 7th, 1821.

I HAVE this day witnessed an experiment, tried on the bottom of H. M. S. Ethalion, by Mr. William Hookey, with a machine of his invention, for stopping leaks in a ship's bottom near the water's edge, and a few feet below it; it answered extremely well, and in my opinion will be found extremely useful in many cases, such as repairing the copper which generally wears first at the water line, getting at the pipes of the cocks of the wash-deck pumps, stopping shot holes, so as to prevent the necessity of careening the ship. In the present trial there was sufficient room for a man to work, and the machine was perfectly dry, although there was a considerable ripple and a strong tide.

ROBERT PULLMAN. *Superintending-Master,*
Woolwich Royal Dock Yard.

May 7th, 1821.

WE do hereby certify, that the machine constructed by Mr. Wm. Hookey, of his majesty's Dock-yard at Woolwich, for the making good any defects under the water-line, in ships bottoms, such as shifting worn copper, stopping of leaks &c., five or six feet under water, answers the intended purposes extremely well; having seen it applied on a frigate's bottom: and we are decidedly of opinion that it is an invention of great merit, and although very simple in construction will be found of great benefit in the navy, and as such is deserving of every encouragement.

D. DUNN, *Captain, R. N.*

HENRY JONES, *Com. R. N.*

THOS. BROWN, *Master-Attendant.*

*Reference to the Drawing of Mr. W. HOOKER's Coffey
for Repairing Ships afloat.—Plate XVIII.*

Fig. 1, *a a a a* part of a ship's side, *b b* the surface of the water shown by dotted lines, *c c* the coffer slung by the ropes *d d d d*, it is sunk by lead weights, and then secured to the ship's side by the twisted ropes and eye-bolts *e e*. The water is then pumped out by the pump *f* and more weights added to resist the upwards pressure of the water, the lateral pressure then forces it very tight against the ship's side, the surface of contact being strengthened and widened by the framing *i i i*, which framing is covered with fearnought *g g* fig. 2, an elastic woollen stuff filled with grease, and surrounded by loose cloth *h h h*, which

the pressure of the water drives into any inequalities and makes it water tight.

Fig. 2 an inside view of the coffer, showing the elastic surface *g g g*, and cloth *h h h*; *k k k* the wash-boards, shown by dotted lines only in figs. 1 and 3.

Fig. 3 an end view of the coffer *c c*, the surface of contact is curved to fit the ship's side, and may be varied to suit different parts by additional chocks or wedges on the surface.

Fig. 4 a bird's-eye view, the same letters of reference serving for all the figures. Fig. 5 a bird's-eye view of one end of the coffer showing the frame *i* the elastic surface *g* and the cloth *h*, drawn half an inch to 4 foot, the other figures are one quarter of an inch to the foot. Fig. 6, one of the weights.

N° XIII.

STEAM-ENGINE-BOILER.

The sum of TEN GUINEAS was this Session given to THOMAS HALL, of Glasgow, for a self-acting Apparatus for supplying STEAM-BOILERS with water. The following Communication on the subject has been received from the Candidate.

To The Society for the Encouragement of Arts, &c.,

The Memorial of Thomas Hall, Engineman to the Glasgow Water Company,

SHEWETH :

THAT your memorialist has been entrusted with the management of steam-engines, for a period of nearly 30 years ; about half of which time he has been in the above company's employ, having at present under his care three of Boulton and Watt's Engines ; one of which is of sixty and the other two twenty-seven horse power each, all of which were fitted up in a complete style, with boilers, feeding and damping apparatus, after the common mode.

Having long been of opinion that the very great consumption of fuel in the working of steam-engines might be much diminished, your memorialist tried many experi-

ments in order to attain so desirable an object. These he conducted with the utmost care, and at length invented what he considers a decided improvement in the apparatus, and the mode of feeding boilers, by means of which he has effected a saving of fuel, amounting to nearly 25 per cent., as will be seen from the accompanying comparative statement of the actual consumption during the last two weeks of his experiments. Instead of allowing the admission of a constant supply of water into the boiler, suited to the proportion of steam required, your memorialist admits a given quantity at stated times. Convinced from his own experience, that the use of this improved apparatus and new mode of feeding will insure the above saving in all works where the power of steam is employed; and as such a saving to works of great extent, and where the price of fuel is high, must to all interested therein, be a matter of great importance, and a strong inducement to its universal adoption, he will endeavour to describe it as exhibited in the drawings relative thereto, herewith sent. (See Plate XIX.)

Your memorialist made the aforesaid experiments with the 60 horse engine, which was worked about 17 hours daily, at a speed of $12\frac{1}{2}$ strokes a minute. Size of the pump 22 inches, stroke 8 feet; height to which the water is raised in the city 130 feet. This engine is provided with three boilers, 16 feet 9 inches long, 5 feet 6 inches wide, and 6 feet 1 inch deep. Length of furnace bars 3 feet 3 inches; width of furnaces 4 feet 6 inches; declivity 1 foot in 3. This construction, though admirably adapted for the common, is far too powerful for the new mode of working, as it does not require such large fires, on which account it has been necessary to contract them nearly one fourth, and two boilers alone are required to

furnish the engine with sufficient steam ; common height of water in the boiler, 3 feet 6 inches. It is well known that when engines are stopt at night, there is always less or more fire left unconsumed ; to which more fuel is generally added, in order to have the furnaces in a proper state for starting in the morning. This strength of fire, it is obvious, must greatly diminish the water in the boiler, so that when the engines come to be set a going, a great deal of water must be let in to make up for the loss sustained by evaporation ; at which time also, a great addition of fuel, and much care and attention are requisite. In order to do away all these, your memorialist adopted the plan of running in a given quantity of water at night, above the ordinary height ; which he found might be done quite safely in boilers of the above size, to the extent of 18 inches. When he began this mode of feeding, he admitted water by opening the stop-cock, on a branch pipe of $2\frac{1}{2}$ inches, which is connected direct from the main pipe conveying the water to the city, with the top of the feeding or damper-pipes. This pipe was originally so placed for filling the boilers after cleaning, instead of having a cistern in the boiler-house for that purpose. It was by having the use of this pipe that he possessed such ample means of ascertaining correctly, not only the extra height to which water might with safety be admitted into the boiler, but of conducting and bringing to maturity the whole process. Before opening the stop-cock, the valve in the damper-pipe which admits the water was kept open by attaching a weight to the float end of the lever. He then had to stand by the upper guage-cock till the quantity of water before specified was run into the boiler. Although he could, by this means, manage the filling of the boiler quite well himself, yet, being a nice point, it

required great care and very constant attention. To save this trouble and to obviate any objection which might besides arise to the general adoption of his plan, from the danger of over-filling, or the inconvenience of not introducing a sufficient quantity, the placing of another float in the boiler above that in general use, suggested itself to his mind; and this he found completely to answer the end he proposed. This second float he fixed at the distance of 18 inches from the first, and counterpoised it by a weight under the common one. Its use may be described thus:—*k l*, figs. 1 and 2, Plate XIX, represent the two floats in the boiler *m*, with their respective counterpoises *n o*. By removing the weight *n*, the floats descend, and consequently open the feeding-valve *p*, fig. 2; water being then admitted by turning the stop-cock, the feeding of the boiler goes on, till the water having reached the upper float, it gradually ascends and shuts the feeding-valve, thereby preventing the admission of water beyond the height already stated; and requiring also the instant shutting of the stop-cock, neglecting which, would occasion waste of water, by overflowing the damper-pipes.

Your memorialist was next led to the invention of the small cistern *g*, fig. 1; this he placed on a level with the top of the feeding-pipe, with which it communicates by the conduit-pipe *i i*. On the top of this cistern, is a valve *c*, rendered self-acting by means of a float *h*, suspended from the lever *e*, and counterpoised by the weight *d*. The action of this improved feeding apparatus may be explained as follows: when the engine is stopt for the night, all that is necessary is the removal of the counter-weight *n*, fig. 2, on which the feeding-valve *p* instantly opens, from the descent of the compound float *k l*; the water then flows along the conduit pipe *i i* from the cistern *g*, causes the

falling of the float *h*, the consequent opening of the valve *c*, and the admission of the water from the main cistern *a* by the pipe *b*. A constant supply is thus kept flowing into the boiler, until by the ascent of the water to the line parallel with float *k*, fig. 1, the feeding-valve is shut; the water, however, continuing to flow into the small cistern *g* raises the float *h*, which shuts off the communication with the pipe *b* by the valve *c*. The feeding of the boilers is thus managed with great simplicity and certainty, the waste of water completely prevented, and attendance at the stop-cock rendered unnecessary. By suspending the lower counter-weight in its place, at the time of setting the engines to work, the farther ingress of water is stopt, this extra 18 inches being found sufficient to work the engine nearly six hours. The running in of a large quantity of water at this time, as well as the care and attention required to be paid to the firing, on the ordinary mode of feeding, are also dispensed with. It has been stated that the quantity of water admitted into the boiler at night, beyond the common height, is 18 inches. This addition, however, from the heat of the furnaces, soon attains a state of ebullition, and a consequent diminution. Here the utility of the self-acting valves in the cistern will be evident; as, whatever waste takes place in the boiler is thereby completely provided for. By the single process of admitting this more than ordinary height of water at night, from 8 to 10 cwt. of fuel is saved. Where engines cannot from the nature of the work be conveniently stopt during the day, the saving from the filling at night only can be obtained; for the weight *n* being an exact counterpoise to the upper float *k*, so soon as the water in the boiler has decreased beyond 18 inches, the under float comes into action the same as if the other had

not been in use, and feeds the boiler in the common way. But, where engines can at any time be stopt to allow the introducing a given height of water into the boiler, the great advantage of doing so will be apparent;—as, when your memorialist at such times of the day as the service would permit, stopt the engine for repairs, opportunity was again taken to admit water into the boilers by removing, as before, the counter-weight n ; this occupied from 30 to 40 minutes, at the end of which time, the steam was quite ready to start the engine, provided the necessary repairs were finished. The waste of fuel during this operation was rendered quite trifling, the dampers being confined somewhat below the working point, by means of a hook and chain. A farther saving of nearly 5 cwt. was obtained by this second filling; a third sufficed for the day's work of 17 hours, when the same result was produced, which completed the saving of about a ton of fuel per day, from your memorialist's new mode of feeding, being nearly 25 per cent as already stated. It is not to this decrease in the consumption of fuel alone, that he would solicit attention: but to the farther saving which will arise, from the boilers and furnaces lasting for a much greater length of time, than they do on the common mode of working; as the comparative statement of the quantity of ashes produced from both methods will in part evince. It also simplifies, as well as diminishes manual labour and attention; and, consequently, lessens the risk and probability of accidents arising from the carelessness, or inattention of enginemen or firemen.

The saving of fuel may be carried to a still greater extent, if the main cistern a were placed in a convenient situation to receive *the warm water from the engine*, and if steam-engine boilers in general were made sufficiently

large to allow the admission at night of the requisite quantity of water for the ensuing day's work, particularly where engines cannot be stopt during the day. Even on the plan of feeding with cold water, the saving would be greater were boilers increased in size, the filling at night being the prime object. But that the consumption of fuel must be vastly lessened by feeding with warm water, there can exist no doubt.

It seems only necessary now, that your memorialist explain fig. 3, which shows the floats, and the manner of fixing them to any given height, by the sliding rod attached to the same lever as the common float. The utility of this invention will be strikingly evident, in those works especially, where engines are stopt at meal hours, or any other time; as, whatever quantity of water may be wanted to be run into the boiler, all the fireman has to do, is simply to remove the counter-weight n , and fix the float k to the height required. The filling will be finished by the time the engines come to be set on, previous to which, the weight n must first be suspended in its place. Thus, no working time will be lost, and besides, the fireman may in the meantime be employed with advantage some other way.

THOMAS HALL.

Comparative Statement of the actual Consumption of Fuel, on the Old and New Modes of Working, and the quantity of Ashes produced.

IN the week ending 24th of 11th Month, 1821, the

engine was worked 103 hours 2 minutes ; the quantity of coal used, 18 tons 12 cwt. ; ashes, 1 ton 4 cwt.

In the week following, the working hours, were 102 hours 55 minutes ; coal consumed, 24 tons 4 cwt. ; ashes, 1 ton 16 cwt. The fires kept in the whole time with the above quantity :—

Last week's consumption on the		<i>tons. cwt.</i>	<i>tons. cwt.</i>
old mode	24 4	Ashes, 1 16
First week's consumption on the			
new mode	18 12	Do. 1 4
		<u>5 12</u>	<u>0 12</u>

Equal to about 19 cwt. less per day, and 2 cwt. less ashes.

CERTIFICATE.

Glasgow Water Works Office,
February 14th, 1822.

I, DAVID DENNY, secretary to the company of proprietors of the Glasgow Water Works, hereby attest and confirm the foregoing statement ; particularly, in so far as relates to the saving of coals, which has been very considerable.

DAVID DENNY.

N° XIV.

MAGNETIC GUARD FOR NEEDLE-POINTERS.



The Large GOLD MEDAL, being the Premium offered, was this Session given to Mr. J. H. ABRAHAM, of Sheffield, for a MAGNETIC GUARD to protect Persons employed in POINTING NEEDLES, and other branches of Dry-grinding. The following Communication has been received from Mr. ABRAHAM, and Models of his Apparatus have been placed in the Society's Repository.

SIR;

Sheffield, Aug. 13th, 1821.

HEREWITH please to receive an apparatus which I have constructed to guard the "dry grinders" from the fatal results of their dangerous occupation. The premature death to which they become victims, must excite the energies of every mind not callous to human suffering.

A description of the safety apparatus and testimonials in its favour are herein enclosed.

I have now only to solicit that you will take the earliest opportunity of submitting the whole to the dispassionate and attentive consideration of the Committee of the "Society instituted for the Encouragement of Arts, Manufac-

ture, and Commerce," and in the interim solicit your acknowledgement of their receipt.

I am, Sir,

A. Aikin, Esq.

&c. &c. &c.

Sec. &c. &c.

J. H. ABRAHAM.

SIR;

Sheffield, Oct. 6th, 1821.

WHEN I sent you the first model of my newly-invented safety-guard or life-preserver for "dry-grinders" and "needle-pointers," I was not aware that the "Society instituted for the Encouragement of Arts, Manufactures, and Commerce," had offered a premium to any person who could invent an apparatus, which would relieve the "needle-pointers" from the injurious effects, which the steel-pointings and dust produced in their employment have upon their constitutions.

My principal object in sending to you the models, &c., was, that through the medium of the Society, the invention might be more widely diffused among the individuals who suffer so seriously from the effects of "dry-grinding;" by your giving publicity to the discovery, if it should be thought by it sufficiently valuable. The feelings of humanity ought always to prevail over those of a mercenary kind, particularly when we find those who are to be benefited by an invention, and yet not enabled to purchase expensive apparatus, groaning under a disease, not to be relieved by the aid of medicine or medical skill. The simplicity of the apparatus, and the small expense at which every one may procure it, put it within the power of every sufferer to obtain relief. The Society may not, perhaps, be in possession of the information, that thousands of individuals in this country, besides the "needle-pointers" who have been regularly employed in dry-grinding have

been cut off at the age of from 30 to 40 years. In the town of Sheffield alone, about 100 persons are employed in dry-grinding, and from the best information I can obtain, I find that about 1,000 more are employed part of their time in grinding upon dry grindstones. The articles ground upon dry stones are steel and cast iron forks, awl blades, fire irons, the backs of razors, &c. &c. Upwards of 1,500 persons are employed in Sheffield and the neighbourhood in grinding upon wet and dry grindstones, and I feel confident that the whole may be benefited by using the safety-guard in different forms.

The small model of the safety-guard No. 1, which was coated with needle pointings at Messrs. Cocker's needle manufactory, Hathersage, Derbyshire, is a fine specimen of the power of magnetism. The larger model, No. 1, is coated with metallic particles and grit-dust which is collected by being placed in front of a cast-iron fork-grinder's stone for a quarter of an hour only, in the presence of Wm. Tooke, esq., a vice-president of the Society. I have improved the guard for the mouth, and have sent you one which was coated at Messrs. Cocker's needle manufactory. The steel, &c. attached to it was collected, as will be seen by their testimonial, in two hours, when it was fixed to the mouth of the pointer, when he was at his employment without the safety-guard over his grindstone. When the safety apparatus is properly placed over the grindstone, there is not more metal collected by the mouth-guard in one day, than there would be in a quarter of an hour if the grindstone was without the apparatus.

When I found that the magnetic safety-guard collected nearly the whole of the metallic particles, and that part of the grit-dust, which incrusts them with a thin film from the temperature produced in grinding, I was determined

to try to collect the remainder of the grit-dust as it rose from the grindstone, and am happy to add that my success has exceeded my expectation. By placing the additional apparatus, which is formed of a frame of wood and a piece of coarse sacking or flannel, closely behind the safety guard, nearly the whole of the metal and dust is secured as it rises from the stone.

Messrs. Cocker's testimonial will, I flatter myself, warrant me in offering myself a candidate for the Society's Gold Medal.

The testimonial, which is signed by several highly respectable gentlemen, will prove to the Society that the advantages to be derived from the use of the safety or life-preserving apparatus by the needle-pointers, will be extended to thousands of suffering individuals; who, after the grinders' asthma begins to afflict them, which generally happens to those regularly employed in dry-grinding when they arrive at the age of 25 or 27 years, linger out a miserable existence till they arrive at the age of 30 or 35 years, beyond the age of 40 years very few dry-grinders are known to live.

Your acknowledging the receipt of the models, &c. will confer an additional favour on,

Sir,

A. Aikin, Esq.

&c. &c. &c.

Sec. &c. &c.

J. H. ABRAHAM.

SIR ;

HAVING seen your invention of the magnetic safety-guard and dust-retainer, or life-preserving apparatus in operation by grinders upon the dry-stone; we think it due to you to bear testimony to its surprising efficacy. The almost impalpable dust and particles of metal which are

arrested by the arrangement of magnets and the retainer, is a sight at once alarming and gratifying. To witness the clearness of the atmosphere in a grinder's room of that description when they are in use, and its rapid impregnation with the dust of the metal and stone on their removal, is enough to produce a thorough conviction of the utility of the invention. Indeed, the satisfaction manifested by the men who use them, and their statement with how much more ease to themselves, they can go through their work, and that they feel less oppression and annoyance in a day's labour with them than in a quarter of an hour without, sufficiently evinces that the deleterious matter has been arrested and detained on its fatal progress to the lungs; where, if it once arrive, a complaint is induced which has hitherto baffled the skill of the medical profession. We anticipate incalculable benefit from their general adoption, and can see no reason whatever to doubt that they will most materially prevent that desolating disorder.

Mr. Abraham.

JOHN FEATHER.

JAMES CAM.

J. FAVELL, *Surgeon.*

HALL OVEREND, *Surgeon.*

THOMAS HOLY.

SAMUEL ROBERTS.

OLDALE AND ELLIN.

JOHN STURDALE, *Surgeon.*

ROBERT SORBY.

T. B. HOLY.

WM. PARKER.

BENJAMIN DAMMS.

JOHN EYRE.

JAMES SMITH.

SIR;

Hathersage, Sept. 21st, 1821.

WITH this you will receive your semicircular frame of magnets, which has been placed in operation over a needle-pointer's stone for the space of half an hour, whilst the pointer was pointing No. 14 wire, and which collected considerably more of the steel and dust in that time; but which we found took fire and burnt off when a quantity was collected, to prevent which it will require frequent wiping or brushing off.

The pointer who has most frequently tried your magnets states that with the use of them, and the damp bag which he has suspended over the stone, he has not more dust &c. floating about him in a whole day than he used to have in a quarter of an hour, and which he is confident will be of considerable benefit to him. We, therefore, request you will lose no time in completing our order of the semicircular frames of magnets as being best adapted for the use of the pointers, that we may put all our pointers in the possession of them, for we are convinced they will be found highly beneficial in preserving their health.

The mouth-pieces which we have herewith returned were placed on the upper and nether lip of the pointer for the space of two hours when the semicircular magnets were not in operation, but whilst the bag was suspended over the stone.

We are, Sir,

&c. &c. &c.

Mr. J. H. Abraham.

COCKER AND SONS.

January 30th, 1822.

WE the undersigned needle manufacturers at Redditch, in the county of Worcester, do hereby certify, that we have examined and made trial of Mr. J. H. Abraham's apparatus, constructed for the purpose of preventing the ill effects of dry-grinding generally, and are of opinion that the said apparatus, with the exception of passing off the stone-dust, is effectual and may be successfully applied for the use of needle-pointers, whose lives are sacrificed at an early period from twenty-five to forty years of age, in consequence of inhaling the small particles of steel-dust, ground from the point of the needle.

WM. BARTLEET AND SONS.

RICHARD HEMMING AND SON.

THOS. WILLIAMS.

WM. BOULTON AND SON.

WM. FIELD.

The mark of W. DUNN, *Needle Pointer*. +

The mark of W. ADAMS, *Needle Pointer*. +

February 26th, 1822.

WE the undersigned needle manufacturers at Redditch, in the county of Worcester, do hereby certify, that we have examined, made trial of, and intend to adopt Mr. J. H. Abraham's apparatus, constructed for the purpose of preventing the ill-effects of dry-grinding generally, and are of opinion that the said apparatus is effectual and may be successfully applied for the preservation of needle-pointers, whose lives are sacrificed at the early period of twenty-five to forty

years of age, in consequence of inhaling the small particles of steel and grit-dust produced in the pointing of needles.

WM. BARTLEET AND SONS.

WM. FIELD.

THOS. WILLIAMS.

RICHARD HEMMING AND SON.

WM. BOULTON AND SON.

HENRY MILWARD.

BENJ. HOLYOAKE.

A. CHAMBERS.

JOHN ENGLISH.

Needle Pointers.

WM. HUNT.

S. LOCK.

WM. DUNN his mark, +

D. TANDY his mark, +

JOHN JOHNSON his mark, +

JOS. THOMAS his mark, +

T. CHESTLESTON his mark, +

E. PERKIS his mark, +

C. TERRY his mark, +

W. CLARKSON his mark, +

JON. JOHNSON his mark, +

G. TERRY his mark, +.

WE the undersigned having witnessed the life-preserving apparatus of Mr. Abraham in operation, beg leave to

add our testimony of the beneficial effects of the same toward the needle-pointers.

REV. J. CLAYTON, A. B.

HUGH TAYLOR, *Surgeon*.

JOHN TURNER, *Hagley Parsonage*.

F. H. G. BARRS, *Haden Hill*.

A. H. BARRS.

R. BARTLEET.

C. BARTLEET.

C. SWANN.

W. CHAMBERS.

SIR;

Bedford-row, April 18th, 1822.

I MUCH regret, that I am prevented by indisposition from attending the Committee of Mechanics this evening, to add my testimony to the efficacy of Mr. Abraham's invention for obviating the deleterious effects of pointing needles, and of dry and wet-grinding in general.

An accidental visit to Sheffield during the last autumn, enabled me to witness the process as to forks and cutlery on an extensive scale.

I saw rooms with nearly twenty persons at work in each, and the contrast between the effect on them and on the atmosphere, while wearing the magnetic guards or without them, was too obvious to escape notice from the most casual observer. In one room the guards as incrustated with particles of steel and iron, after being in use one quarter of an hour were in my presence placed and secured in a box which I have since inspected at the Society's house and which will no doubt have been submitted to the Committee; owing however, to the packing and to the motion of the carriage, many of the finer particles have been dislodged, by which means the singularity of the ap-

pearance of the guards when fully bearded with the filings has been much diminished.

The workmen employed appeared thoroughly impressed with the beneficial effects of the contrivance, and adopted it with alacrity and gratitude, and I have no hesitation in stating my opinion, that, whether considered as a novel and ingenious application of the mysterious power of the magnet, or with reference to the more important object of alleviating one of the evils incident to some of our manufacturing processes, and thus rendering them consistent with the paramount claims of humanity, this invention ranks as high as any that has ever been submitted to the Society ; and I am confident that the committee will duly appreciate the merit of the inventor.

It may be necessary here to remark, that I have had no opportunity of witnessing the effect of the guards in question, in the pointing of needles, which I believe is the immediate subject of our proposed premium ; my testimony applies to the grinding of cutlery both wet and dry, a process, as I am informed, scarcely less prejudicial to the workman ; and, therefore, this additional application of the protection may probably be considered as entitling Mr. Abraham to some farther token of the Society's approbation, of efforts so meritoriously and successfully made, in promoting its views of practical utility.

As far as I was informed, Mr. Abraham has no ulterior views of profit from his invention ; but, on the contrary, has most benevolently aided many poor workmen in procuring the guards at the cheapest rate. He is master of a considerable school at Sheffield, and is otherwise zealously attached to physics as a science, and to many branches of experimental philosophy.

In the promotion of this particular invention, he has

devoted much time and expended some money in travelling as he was able to find leisure during his few and short vacations, to the several manufacturing districts in the neighbourhoods of Sheffield and of Birmingham.

I am, Sir,

A. Aikin, Esq.

&c. &c. &c.

Sec., &c. &c.

WM. TOOKE.

Reference to the Engraving of Mr. J. H. ABRAHAM'S apparatus, for preventing the prejudicial effects of dry-grinding.
—Plate XXIII.

Figs. 1 and 2 are a section and a back elevation of a needle-grinder's wheel in which *a* points out the wheel, *b b* the trams on which it is mounted, *c c* cross-rails framed between the trams: *d* the grinder's seat supported on a bracket, *e* an iron guard, which protects the grinder in the event of the stone breaking, and *f* the needles in the act of being ground.

It is proposed to protect the workman from the iron and grit-dust which he produces and inhales, by suspending from the ceiling of the grinding-room a sheet of canvass (painted or not), which shall extend from wall to wall immediately over the axis of the stones. This canvas is to reach to the floor and is to have two vertical cuts in it from the bottom upwards at each wheel, and the slip of canvas thus partially disengaged is to be turned upwards and made to fasten at various heights, either by a hook or button to accommodate the various diameters of the wheels which may be employed; *g g g' g'* represent the canvass,

the line at $g' g'$ pointing out a division in it by which the workman gets through to his work, this opening is afterwards secured by buttons or hooks; h is the slip cut out to admit the stone, turned up and buttoned at h' leaving an opening about $1\frac{1}{2}$ inch high over the stone through which the iron and grit-dust is violently impelled by the centrifugal force, as described by the dotted lines i fig. 1. The stream of dust generally maintains a state of brilliant ignition and moves in the direction of the tangent with extreme velocity, for at least twelve inches from the points of the needles; there is therefore no difficulty in conveying by far the larger portion of it into that part of the building separated from the workman by the canvass, and the current produced through the aperture by the revolution of the stone, will effectually prevent its return. A few, however, of the lighter particles rise almost perpendicularly from the points of the needles, and these it is proposed to arrest by one or more rows of octagonal magnets suspended nearly over the points of the needles as $k k$ &c.; they may be fixed in a bar l , resting and capable of moving up and down on two uprights $m m$ supported either on the trams $b b$ or secured to the iron guard e . The canvass besides the apertures already described will require some cutting and adapting to fit as nearly as possible the irregularities of the trams, &c. but all this will be quite obvious and must depend on the particular construction of the mill to which it is applied. A wooden partition might be used with perfect success instead of the canvass, but for the circumstance that the trams and stones are moved forward as the bands which impel them are shortened by rejoining after having broken, and the pliability of the canvass screen renders it peculiarly fitted for adapting itself

to this change of place. A slight attention to the mode of uniting the bands would make a wooden partition perfectly applicable.

The apparatus described in the engraving has been partially used at Redditch, and as the testimonials show, has been proved to be effectual. The principal difficulties which oppose its general and successful adoption arise from the nature of the buildings in which the work is performed, and from the habits of the men employed in them. In a building about twenty feet long, not so many high, and nine or ten feet wide, from six to nine men work; they are placed on three stages or shelves about six or seven feet wide, occupying one end of the building; the other end contains the machinery. The men sit close to the end wall, and are essentially all in one room, or rather, worse than they would be in one room where all worked on the same floor, for the stages are scarcely far enough apart to allow a man to stand upright, and the dust falls through the joints from one to the other. These grinding-houses are sometimes built in pairs, and in consequence of this a strong side wind which would otherwise be useful, merely blows the dust from the windward to the leeward house. Added to all this, the use of water as a power acting on overshot wheels, occasions the mills to be erected in situations where they are shut up on three sides, by banks nearly as high as their roofs. The result of the whole is, that the air is nearly stagnant, that the immense quantity of iron and grit-dust hourly produced, rolls slowly about the rooms, till the atmosphere has become so fully impregnated that the men are scarcely visible on entering at the door; it then begins to be deposited on the floors and timbers, from which it is again disturbed by the motion of the machinery. On each side of the building, in a line with the

axles of the wheels, are windows, which it is impossible to close, in the severest weather, and it frequently happens that the water, in which the needles are dipped, will freeze on the hands of the workman. It will be requisite, therefore, for the full success of Mr. Abraham's contrivances, that a greater space be left between the workmen and the wall behind, otherwise the canvass partition confines them in a space so small, that in summer it attains a temperature almost suffocating. It will also be advantageous that the window be divided into two portions, the division corresponding with the canvass partition. The part next the workman should have a glazed casement, to be shut when the weather required it, while the other part might be permanently open.

Although it is true that some of the pointing mills, are not subjected to all the defects of construction and situation which have been enumerated, they are without any exception confined in space, and ill-ventilated. It will be evident therefore, that the complete reformation of the mischief, must depend upon measures to be taken by the larger needle-makers themselves. The benevolent and persevering exertions of Mr. Abraham, must be seconded by them to have any sensible effect. If the early production of a lingering disease, and its consequence a premature death, among a whole class of men, be evils worth remedying, there is no case which calls so loudly for interference, as that of the needle-grinders. Nor is the sacrifice of health and life the only nor perhaps the greatest evil. The workmen are necessarily allured to their pernicious employment by high wages, which as necessarily produce their universal accompaniment, idle and dissolute habits. The excessive earnings of the needle-pointers at Redditch maintain a succession of men, who taint the whole neigh-

bourhood with profligacy ; who with the most perfect consciousness, devote themselves to an early death for the sake of a life of idleness and debauchery, and who acquire such a callous indifference to the fate which they know awaits them, that their apprehensions are said to have been excited, lest Mr. Abraham's inventions should be successful enough to affect their wages.

The case of the dry-grinders at Sheffield and other places, though not so appalling as that of the needle-grinders, is sufficiently bad. They work in rooms which are, generally speaking, much better ventilated, and under circumstances which admit of a very simple mode of preventing the dissipation of the dust in the air. Fig. 3 represents a section of a Sheffield grinder's wheel, of which, fig. 4 is a cross section, and fig. 5 a bird's-eye view. In all these figures, *a* is the wheel which runs in a cast iron trough *b b* ; the grinder sits on the block *c*, which lies on the edges of the trough, and holds the article to be ground at *d*, the stream of iron and grit-dust taking the direction *d e*. To retain this dust, a piece of canvass *f f*, formed so as to embrace rather more than a quadrant of the wheel, is suspended from the board *g*, which lies loosely on the trough ; the board is notched round the wheel, and over the opening three canes or hazel twigs *h h h* are bent, forming an arch to support a canvass hood. The board *g* is easily lifted from its place for the purpose of wetting the canvass (which must be kept damp), and is as easily returned when that is done. In this manner the whole of the dust is arrested by some part of the canvass, and being retained there by the moisture, requires only to be occasionally shaken out. For further security, an arrangement of magnets (fig. 6), may be fixed in a semicircular frame, and this frame may be placed at the opening into

the canvass hood, or in any other place which the peculiar circumstances of the case might dictate to the workman. In addition to the radial magnets, other intermediate ones may be fixed on the face of the semicircle, as shown in the side view fig. 7. In all these cases octagonal magnets are recommended in preference to round or square ones, because the particles of iron seem to obey the magnetic influence with more force at the angles of the bar than at its surfaces. The magnets should be forged of steel bars about a quarter of an inch square, the attractive power not appearing to reside above a tenth, or an eighth of an inch within the surface.

For the protection of the workman against the small quantity of dust, which, in spite of every precaution will float about the rooms, and especially during the operation of *raising* the stone when the ordinary apparatus will not apply, Mr. Abraham has constructed a muzzle (see fig. 8), formed of a frame of wood, the upper and lower pieces made circular to fit the lips; on this are fixed two or three thicknesses of crape or muslin, and it is studded with sixteen magnets, which will arrest a considerable portion of the deleterious matter before it can reach the crape; to the upper part of the wooden frame is attached a bent wire, to which crape is fixed for the purpose of protecting the nostrils. The whole is fastened by two strings passing round the head and tying behind. It has also been found that a semicircular frame similar to figs. 6 and 7, but without feet, having the magnets only on the face, may be worn round the neck with considerable advantage.

N° XV.

DETACHED ESCAPEMENT.

The Large SILVER MEDAL was this Session given to Mr. GEORGE SAVAGE, of St. James's Street, Clerkenwell, for his DETACHED ESCAPEMENT. The following Communication has been received from the Candidate on the subject, and a Model of his Invention has been placed in the Repository of the Society.

SIR;

5, St. James's Street, Clerkenwell.

It is generally admitted by scientific practitioners in the watch trade, to be an important *desideratum*, to have an escapement produced that shall at once combine simplicity of principle, precision of performance, and cheapness of execution. An object that has long and much occupied my attention, and which, I persuade myself, is accomplished in the improved anchor or detached escapement herewith sent. It combines the most essential properties of the anchor, duplex, and detached. It is free from that extreme delicacy, which renders the two latter liable to be injured in the hands even of good practical workmen, and the watches may, in this respect, be repaired by persons understanding merely the first prin-

ciples of the art ; it is, therefore, the best article of the kind for exportation.

From the friction being less, it requires a comparative small portion of power to keep it in motion, nor will it, as the other escapements, remain at rest, and is therefore less liable to stop, and it will perform without oil, except in the pivot-holes, which properties taken in conjunction with its comparative cheapness of execution, will entitle it to pre-eminence, among similar productions of art.

Under such impressions, and from the encouragements given by the Society of Arts, so laudably and beneficially instituted, to stimulate, patronize, and promulgate useful discoveries, I most humbly and respectfully submit the escapement for inspection, hoping thereby, to realize that best reward for inventive exertion, the approval of gentlemen entertaining enlightened views of the useful arts, and united for the purpose of giving them extensive effect.

I am, Sir,

A. Aikin, Esq.

&c. &c. &c.

Sec. &c. &c.

GEORGE SAVAGE.

Reference to the Engraving of Mr. GEORGE SAVAGE's Improved Anchor or Detached Escapement.—Plate XXII.

Fig. 1st, *a b* the locking detent ; *c d* the lever fixed on the same axis with the detent ; *c* the fork of the lever ; *e* the unlocking pallet, fixed on the balance staff ; *f* the impulse pallet, fixed on the balance staff ; *h* the escape wheel ; *i* a roller fixed on the balance staff ; *k*, a small cock or safety point, fastened to the under side of the lever at the fork end : *l m* banking pins.

Fig. 1 represents the wheel locked by the detent *a*, the unlocking pallet *e* having just entered the fork *c*, is beginning to unlock the wheel; that prong that is now receiving the unlock-pallet *e* stands in a right line with the center of the detent *a* *b*, and the balance staff: as the unlocking pallet *e* leads the lever towards the banking pin *l*, the impulse pallet *f* advances, and the detent *a* recedes from the tooth, and when the unlocking pallet *e* has led the lever up to the banking pin *l*, which is about 4° , the detent *a* will be disengaged from the tooth that locks upon it, and the impulse pallet *f* will have advanced a little past the point of intersection to receive its impulse from the escape wheel.

Fig. 2 represents the unlocking-pallet *e* just parting from the fork *c*, having led the lever up to the banking pin *l*, the detent *a* is disengaged from the tooth of the wheel, and the impulse pallet *f* which has arrived past the point of intersection, now receives its impulse from the escape wheel, which continues through 44° of its vibration, and the detent *b* has already advanced to lock the wheel when the impulse is completed.

Fig. 3 represents the tooth of the wheel, having discharged the impulse pallet *f*, which has led the balance 44° , and the wheel is now locked by the detent *b*; the balance continues its vibration through 225° from the commencement of its impulse; having arrived to the extent of its vibration, the power of the pendulum-spring brings it back, and the unlocking pallet *e* enters the fork and leads the lever up to the banking pin *m*, which unlocks the wheel from the detent *b* with a little drop, as is represented in fig. 1, and the vibrations are repeated. *k*, a small cock or safety point, fixed to the under side of the lever at the fork end, this cock effectually prevents the fork from being removed, during the vibration of the balance, this cock is made to pass a hollow in the roller *i*, and

can only pass when the unlocking pallet *e* is leading the lever from one banking pin to another.

Fig. 4 is an elevation (the same letters of reference serving for all the figures), *a b* the locking detent; *c d* the lever; *e* the unlocking pallet; *f* the impulse pallet; *h* the escape-wheel; *i* the roller with a hollow or notch to receive the safety point; *k* the safety point or cock fastened to the underside of the lever at the fork end.

In these four figures the pallet *e* and roller *i*, are represented as united in one piece; fig. 5 represents them as separate.

Fig. 6 a bird's-eye view of the same.

Fig. 7 represents the lever *c d* and unlocking pallet *e*, together; the dotted lines show the limits of their action.

N^o XVI.

RAT TRAP.

The Sum of FIVE GUINEAS was this Session given to Mr. S. BOWLER, 34, Uxbridge Street, Newington Causeway, for a RAT TRAP, which has been placed in the Repository of the Society.

THE principal novelty in this trap is, that it may be set to go off, so as to take one or more rats up to twelve at a time, according as may be judged proper. The trap is

discharged by pressure on the platform where the bait is placed, and the wire or catch, the release of which allows the springs to close the doors, has several notches of different degrees of obliquity; and, therefore, requiring a greater or less weight to discharge the trap according as the ring is placed on a notch less or more oblique.

The floor of the trap should be strewed with flour or meal, and the best bait is a red-herring stitched through and through repeatedly with strong thread which prevents the rats from tearing it in pieces, and by entangling their teeth causes them to crowd close to each other on the bridge or platform, till their accumulated weight is sufficient to discharge the spring.

It appears from the testimony of Mr. Ford, a baker, that he had repeatedly taken from eight to twelve rats at a time in this trap.

Reference to the Drawing of Mr. S. BOWLER'S Rat Trap.
Plate XVII.

Fig. 2 is an end view of the trap set, forming a thoroughfare, both ends being alike; fig. 3 is a side view of the trap also set; fig. 4 is a section with the flap *g* set, and flap *f* down; fig. 5 is a bird's-eye view with flap *f* set and *g* down: the same letters of reference serving for all the figures. *d d*, *e e* the sides of the trap, *f* and *g* the two flaps; each flap has a wire button *h* and *i*, by which it is suspended on the bent ends of the wires *k k* and *l l*; the other end of the wire *k* is bent as shown in fig. 3 to go under, and be kept down by the longer wire *l*, and this wire is detained by the ring or catch *m* which is the end of a

wire that crosses the middle of the trap, and supports the platform only in the middle by means of a piece of bent iron n fixed under the half o , the other half p is supported by o , a plate of iron q being nailed on p to cover the gap between them and to rest on the half o ; figs. 6 and 7 show the joint at the other end of the wire or catch m with the piece n that supports the platform resting on it. The flaps are urged downwards by spiral springs $rs\ rs$ the end r being fastened to the flap, the end s resting on the next wire, the bait is put on a hook t fixed to the middle of the side dd shown in fig. 5 under the wires.

Now when the rats come in and stand on the two boards o and p (which are jointed at vv by two staples to each, and wires crossing the bottom of the trap), their weight presses down the wire or catch m so as to slip off the wire l and let it go, it then flies up as shown by dotted lines in fig. 2, and the wire k also flies up with it; their bent ends (which before supported the flaps) are then turned downwards and let go the flaps as shown at f , and at the dotted lines g , fig. 4, and the rats are thus inclosed. That their tails may not be pinched, there are stops uu , figs. 2 and 4, to receive the flaps before they can touch the bottom. Two pins are also fixed at w to guard and guide the wire l ; xx are two wire buttons to keep the wires k and l down while baiting and setting; when the trap is set they are turned out of the way, as figs. 3 and 5; yy are two tumblers which fall on the flaps, and prevent them from being raised again by the rats, pins are placed adjacent to the buttons h and i so as to make them stick when in the right position for setting, zz are two flap entrances one at each end to admit more rats after the main flaps have been discharged: one of them has a chain and ring by which it may be raised, and in fig. 2, there is a pin hanging by a

chain which may be run through a hole in the side of the trap to fix up the flap, while driving the rats into a receiving cage, that they may never be killed or hurt in the trap, as the smell of their blood would deter others from entering. In order to set the trap to catch one or more rats, the end of the wire l is notched, fig. 8 shows the notched end larger, the bottom step is straight, and will go off with the weight of one rat, the next is a little sloping back, the third a little more, and the fifth most of all, so as to require the weight of 8 or 10 or more rats to discharge it, estimating the weight of a full grown rat at $\frac{1}{2}$ lb. The edges of the two small entrances $z z$, the ends of the flaps fg , and of the platform op are sheathed with thin iron to preserve them from being injured by the rats; a pin shown by a dotted circle a fig. 4 projects from the side d to prevent the platforms from rising high enough to get out of their place, the figures are one-sixth the real size.

N° XVII.

INSTRUMENT FOR MARKING A SHIP'S PLACE
ON A CHART.

The Large SILVER MEDAL was this Session given to Mr. EUSTACE WIGZELL, 10, New Milman-street, for an INSTRUMENT FOR MARKING A SHIP'S PLACE ON A CHART. A Model of the Instrument has been placed in the Repository of the Society.

THE ordinary way of marking off on a chart, the course of a ship is, to prepare a reticulated blank chart, that is, one divided into quadrilateral figures by the intersection of the parallels of latitude and longitude drawn for every 10° ; and then, by means of a parallel rule and compasses to mark within the proper square, the place of the ship according to the latitude and longitude obtained by observation. In doing this, however, the errors arising from deflections of the parallel rule and inaccuracy of the compasses are often considerable; and, in order to avoid these, the candidate has invented the instrument, a description of which follows. The instrument figured was made expressly for Horsburgh's East India Charts, Nos. 5 and 6, but the principle may be adapted to any other chart.

Fig. 1, Plate XX, shows the instrument as applied to a chart, and consisting of two pieces or arms placed at right angles to each other. The vertical piece marked chart No. 5, is a latitudinal scale graduated for Horsburgh's East India Chart of that number, the cross piece is a longitudinal scale for the same chart. The instrument is made of box wood except the slide *a* and that part of the cross scale which clips the vertical one. The slide traverses in the groove made in the vertical piece, and from its considerable length scarcely admits of any play or shake in the cross piece; the clip, by firmly embracing the vertical piece, adds still farther to the precision of the instrument.

Fig. 2 shows the latitudinal scale separate, but presenting the face opposite to that in fig. 1, and graduated for chart No. 6. It has a groove in each side as shown by the section fig. 3, to receive the slide *a a*. Fig. 4 is an edge view showing the graduation on that surface, and the manner in which the brass clip embraces the vertical piece.

To use the instrument, fix the longitudinal scale so as to allow the upper part of the brass to cut the latitude given; then place the instrument flat on the chart—the base line of the perpendicular scale to be on the nearest parallel of latitude lower than the spot to be marked, and the inside edge of the same scale, on the meridian of longitude to the westward of the required point. The extreme line of the longitudinal scale will then intersect the next meridian. The given point of longitude may be marked with a pencil, and it will, of course, show the exact position of the ship on the chart.

N° XVIII.

SCALE FOR CORRECTION OF TEMPERATURE
AS APPLIED TO THE HYDROMETER.

The GOLD VULCAN MEDAL was this Session presented to Mr. ALFRED AINGER, for his SCALE FOR THE CORRECTION OF TEMPERATURE, AS APPLIED TO THE HYDROMETER. The following Communication has been received from Mr. AINGER on the subject.

THIS scale is formed generally on the principle of that rewarded two years since by the Society, and published in the 38th volume of its Transactions.

The stem of the hydrometer is supposed to be graduated so as to give accurately the strength of mixtures of alcohol and water at some one temperature, which may conveniently be 55° of Fahrenheit. The particular construction of the hydrometer is not material; the divisions may be either the natural series shewing at once the strength, or they may be arbitrary, like those in Sykes's; if the former, the stem may be made long enough to contain the whole range, or weights may be used, and different portions of the range engraved on different faces of the stem. In either case a counterpart of the divisions in the stem must be engraved at greater length on a wooden, ivory, or metal scale; and it is proposed, in order to avoid the multiplication of instruments, that for this purpose

the back of the thermometer be used, which, as the observation is required to be made immediately after the temperature has been taken, is conveniently in the hand for the purpose.

The middle range of divisions in fig. 2, plate 24, may be supposed to represent the counterpart of those on the stem of the hydrometer; by the side of these are to be engraved others, corresponding with 1 degree of Fahrenheit, and embracing so much of the middle scale as comprises the amount of affection produced by a variation of 1° in the temperature. On one side (the left) of the middle scale are to be engraved the corrections for variations in temperature below the mean (55°) and on the other side (the right) those for variations above the mean. The former of these is called the *ascending*, and the latter the *descending, correcting* scale; the middle line of divisions may for sake of distinction be called the *indicating* scale.

The correcting scales are to be used in the following manner; for every degree that the temperature of the liquor under examination falls short of 55° or the mean, one division is to be counted upwards on the ascending scale, from the point which the hydrometer gave as its strength, but which would be evidently too low, because the specific gravity of the fluid would have been increased by its defect of heat. In the same manner one division is to be counted downwards on the descending scale for every degree of heat above 55° . Thus, in the first instance, if the thermometer stood at 48° , which is 7° below the mean, seven divisions must be counted upwards on the ascending scale; and in the second, if the thermometer stood at 60° , which is 5° above the mean, five divisions must be counted downwards on the descending scale. To facilitate the observations as to the excess or defect of temperature, the thermometer is to have an additional

graduation, as shown in figure 1, which commencing from 55° as its zero, is numbered above and below that point for about 25° , which includes the extreme limits of temperature, under which liquors are liable to be examined. The part above the zero may be marked by the word "DESCENDING," that below by the word "ASCENDING," which will refer to the correcting scale to be used.

The necessity for two correcting scales, arises from the circumstance, that an error amounting in some cases to one tenth per cent would be incurred by using the same scale to make the correction both for excess and defect of temperature; the two scales also facilitate the correction by substituting the operation of addition for the more difficult one of subtraction, which with one scale only must be used for correcting the effect of high temperature.

To construct the scale, it is necessary to have a set of experiments, showing the specific gravities of a series of mixtures of alcohol and water at various temperatures, the proportions of those mixtures given in terms, both of their weights and bulks, and it will be necessary to have the quantity of condensation occasioned in the several mixtures by the chemical union of the two fluids. All these particulars are given in the extensive tables, published by Mr. Gilpin, in the Philosophical Transactions for 1794. The perfect accuracy of those tables is not essential to the present purpose which is merely to point out how the results of similar experiments may be applied to the construction of scales, such as have been alluded to. It must however be recollected, that the language in which the strength of spirits is usually expressed, differs from all the terms in the tables above-mentioned, depending, as will be seen, neither on the specific gravity of the mixture, nor the relative proportions of the constituent fluids. The indications of the hydrometer are

given in terms evidently derived from the application of the instrument to purposes of revenue, and which are founded on the arbitrary assumption of a particular mixture of alcohol and water, to which, as a standard, all other combinations are referred. This standard is called "Proof," and the difference between it and any mixture of alcohol and water is described by saying that the latter is a certain quantity per cent above or below "proof;" meaning, in the first case for instance, that one hundred gallons of a mixture which is *ten per cent above proof*, may be reduced by the addition of water to one hundred and ten gallons of *proof*; and in the second, that one hundred gallons of a mixture which is *ten per cent below proof* contains alcohol enough for only ninety gallons of *proof*. It may here be remarked, that for the reduction to proof of one hundred gallons of spirit ten per cent above proof, it is not enough to add just ten gallons of water, because the chemical union of the two fluids would condense the two quantities into something less than one hundred and ten gallons, perhaps into one hundred and nine and a half; rather more therefore than ten and a half gallons of water must be added, and precisely the same remark will apply to the supposed abstraction of water from a mixture which is below proof.

For the reason before stated, that none of the expressions in Gilpin's Tables are given in the same terms as those of the hydrometer, a method of reducing the one to the other must be obtained. By a late act of parliament it is determined, that proof spirit at 51° shall weigh twelve thirteenths of an equal bulk of distilled water; if, then, we divide 12 by 13, we obtain $\cdot 92308$ for the specific gravity of proof spirit at 51° , as compared with water of the same temperature; but as water is supposed to be at 60° when it is made the standard of comparison with other specific gravities, we must multiply $\cdot 92308$ by $1\cdot 00063$ the specific gravity of water at 51° , which

gives $\cdot 92366$ for the specific gravity of proof spirit at 51° as compared with water at 60° .

Now, by referring to Gilpin's Tables, under the head " 51° " it appears that a mixture of 100 parts by weight of alcohol* and 80.85 of water, has the specific gravity ($\cdot 92366$) of proof spirit; the same quantities by measure or bulk are 100 of alcohol, and 67.00 of water, which will be concentrated or condensed, 4.63 by mixture, leaving 162.37 as the quantity of proof spirit at 51° resulting from 100 parts of alcohol at the same temperature. But as 55° is the zero of our thermometer scale, the constituents of proof spirit must be obtained at that temperature by transferring the observations already made to the Table, headed " 55° ;" for although 100 and 80.85 will remain at every temperature, the invariable proportion *by weight* of alcohol and water in proof spirit, yet the *bulks* of those proportions will vary with every loss or accession of heat, as an instance of which, the *bulks* which at 55° , correspond to the *weights* 100, and 80.85 are 100 and 66.87, these will be concentrated 4.57 by mixture, giving 162.30 for the quantity of proof spirit at 55° producible by 100 parts of alcohol. From these data the combinations in the tables may easily be described by equivalent expressions in the language of *per-centages* above and below proof; for having found that 100 parts of alcohol will produce 162.30 parts of proof spirit; if we suppose so much water added to 100 parts of alcohol, that the concentrated mixture is a quantity which requires either to be increased or diminished one-tenth to give the number 162.30, such mixture is evidently ten per cent

* By alcohol is meant the strongest spirit mentioned in Gilpin's Tables, which has a specific gravity of $\cdot 825$ at 60° , and in this sense the word is used throughout the paper. Alcohol is commonly sold weighing but $\cdot 815$ at 60° , and it is well known that it can be procured much lower.

above or *below* proof, according to the definition already given.

To proceed with calculating the places of the divisions on one of the correcting scales, say the ascending, supposing that the counterpart of the indicating scale is engraved in the manner shewn in figure 2, continue the proof-mark across the correcting scales. It will be observed, that the place of proof is designated by the letter P, and that the figures 1, 2, 3, &c. above and below, signify so much per cent above and below proof, the intermediate marks being tenths per cent. From the point coinciding with proof on the left hand or ascending scale, we will begin to calculate the place of the fourth division, which will correspond with the alteration produced in the apparent strength of proof spirit when it is examined at 51° , which is 4° below the mean; or in other words to find what combination of alcohol and water has the same specific gravity at 51° , as proof spirit has at 55° . To ascertain this, refer to Gilpin's Table, headed 55° , it shows as we have before seen, that 100 parts of alcohol and 80.85 of water by weight, or 100 of alcohol and 66.87 by bulk reduced to 162.30 by condensation compose proof spirit. Observe next what is the specific gravity of this combination, and a short calculation to give the terms intermediate to those in the table, gives .92196; look now in the Table, headed 51° , and ascertain what proportions in weight have the same specific gravity at that temperature; another short and similar calculation to interpolate the terms, gives 100 alcohol and 78.02 water; find next in the table 55° , what are the proportions in bulk of these weights, which are 100 alcohol and 64.52 water condensed 4.47 by mixture, and leaving 160.05 as the total quantity of spirit; but as this quantity contains as much alcohol as was found necessary for producing 162.30 of proof spirit, it is evident that it is above proof; how much may be ascertained thus; subtract 160.05

from 162.30, multiply the remainder by 100 ; and divide the product by 160.05 ; the quotient is 1.406, showing that when spirit appears proof at 51° it is actually 1.406 per cent above proof ; this therefore is the place of the fourth mark above proof on the ascending scale, being that which is numbered 196 in figure 2. To find the fourth point above this, or the eighth from proof, take the last obtained combination in weight, viz. 100 and 78.02, agreeing with 1.406 above proof ; observe its specific gravity at 55° ; it is .92025, and the combination in weight, which at 51° has the same specific gravity, is 100 and 75.26. Transfer these terms to the Table 55°, and set down their correspondent values in bulk, viz. 100 and 62.24 condensed 4.38, and producing 157.86 of spirit evidently stronger than the last, because the same quantity of alcohol is preserved in all the cases ; repeating the former operation

$$\frac{100 (162.30 - 157.86)}{157.86} = 2.813 ; 2.813 \text{ is therefore the}$$

place of the eighth point on the ascending scale above proof ; by continuing this process, a series of terms will be obtained rising to about 70 per cent above proof. For the present let it be supposed, that the five first only are found, viz. 1.406 ; 2.813 ; 4.192 ; 5.582 ; 6.973 ; from which we learn that spirit which at 51° appears proof is really 1.406 per cent above ; that that which at 51° appears 1.406 per cent above is really 2.813 above ; that which appears 2.813 above, is 4.192 ; that which appears 4.192 is 5.582, and that which appears 5.582 is 6.973 ; but the sum total of these five affections of 4° each, ought to correspond with the amount of alteration produced by 20° ; that is to say, that spirit which at 35° or (55—20) appears proof, should be really 6.973 above ; this however will not be the case, for observing in Gilpin's Table headed 35° what combination has the same specific gravity (92196) as proof at 55° we find 100 of alcohol and 67.67 of water by weight, composed in bulk at 55° of 100

alcohol, and 55·96 water, condensed 4·08, and leaving 151·88, which by the former operation

$$\frac{100 (162·30 - 151·88)}{151·88} = 6·861, \text{ appears to be } 6·861 \text{ per cent}$$

above proof; now it is clear, that the nature of the scale requires, that this and the number 6·973 before obtained should be convertible quantities, and, therefore, this method of correction cannot be theoretically accurate; the error may, however, be so divided as to be unobservable, by calculating all the terms at intervals of 20° and then interpolating the intermediate ones; thus the error of 112 or (6·973 - 6·861) per cent will be divided so that, only one-fifth of that quantity, or ·0224, little more than one-fiftieth per cent, will be the error attaching to a correction for 4° of temperature; in a few instances it may amount to ·033, or one thirtieth per cent; these are however, its extreme cases, and it will be found to amount on an average, to not more than ·010 or one-hundredth per cent.

It now only remains to give one example of each of the calculations necessary for forming the correcting scales; the same principle is pursued in each, but the process is slightly modified, as the term sought happens to be on the ascending or descending scale, and as it is above or below proof, thus making four variations of which the following are examples:

The place of the twentieth division, on the ascending scale, above proof, has been already found to be 6·861, and, against this point on the indicating scale must be placed a mark, the intermediate twenty terms must be interpolated in a ratio similar to that of the five terms of 4° each, already found, viz. 1·406; 2·813; 4·192; 5·582; 6·973; whose progression is as nearly arithmetical as possible, and for all the purposes of an hydrometer, may be considered quite so; indeed it is evident from an examination of these expressions, that the last

figure of each decimal is incorrect, arising from the unavoidable errors in the tables themselves. It will not be necessary to show how to obtain the fortieth, sixtieth and subsequent divisions in this part of the scale, and there can be no difficulty in again dividing these into smaller terms, corresponding each with 1° of Fahrenheit.

For finding the twentieth place below proof on the ascending scale; having before obtained the component parts of proof spirit, by weight, viz., 100 of alcohol, and 80·85 of water, look in the Table, headed 35° and observe the specific gravity of such a mixture at that temperature which will appear to be ·93036; next ascertain the bulks of spirit and water, which at 55° have the same specific gravity; they are 100 and 79·78, condensed 5·06, leaving 174·72; then

$$\frac{100 (174\cdot72 - 162\cdot30)}{174\cdot72} = 7\cdot109 \text{ which is the place of the}$$

twentieth division below proof. The fortieth, sixtieth, and subsequent places will be found in the same manner, and the intermediate points determined as before.

To compute the descending scale, or that which gives the correction for temperature above the mean; beginning with the twentieth place above proof. Refer to the Table, headed 75°, for the specific gravity of 100 of alcohol, and 80·85 of water, which gives ·91322; this at 55° corresponds with 100 of alcohol, and 55·79 of water by bulk or measure, which is condensed 4·08 leaving 151·71.

$$\frac{100 (162\cdot30 - 151\cdot71)}{151\cdot71} = 6\cdot98 \text{ the required place of the}$$

twentieth division above proof; for the twentieth below, find the specific gravity of proof at 55°, viz. ·92196 corresponding to which at 75°, is 100 of alcohol, and 96·67 of water, whose bulks at 55° are 100 and 79·94, condensed 5·07 leaving 174·87

$$\frac{100 (174\cdot87 - 162\cdot30)}{174\cdot87} = 7\cdot188.$$

The following Tables show the places of each division for an hydrometer, adapted to give the strength of spirits, from alcohol, down to Seventy per cent below proof. They are calculated from Gilpin's Tables, the measures of the alcohol and water being taken in every case to two places of decimals, and the specific gravities to five, one row of figures shows what part of the indicating scale the point should be placed against, the other, the values of the intervals between each successive point.

ASCENDING SCALE.					
69.86	0.96	28.71	1.23	20.62	1.57
68.90	0.96	27.43	1.23	22.20	1.58
67.94	0.97	26.25	1.24	23.80	1.60
68.97	0.98	25.01	1.25	25.41	1.61
65.99	0.99	23.76	1.26	27.04	1.63
65.00	0.99	22.50	1.26	28.68	1.64
64.01	1.00	21.24	1.27	30.34	1.66
63.01	1.01	19.97	1.28	32.01	1.67
62.00	1.02	18.69	1.29	33.70	1.69
60.98	1.02	17.40	1.29	35.40	1.70
59.96	1.03	16.11	1.30	37.11	1.71
58.93	1.04	14.81	1.31	38.83	1.72
57.89	1.05	13.50	1.32	40.56	1.73
56.84	1.05	12.18	1.32	42.30	1.74
55.79	1.06	10.86	1.33	44.04	1.74
54.73	1.07	9.53	1.34	45.77	1.73
53.66	1.08	8.19	1.35	47.49	1.72
52.58	1.08	6.84	1.35	49.19	1.70
51.50	1.09	5.49	1.36	50.87	1.68
50.41	1.10	4.13	1.37	52.52	1.65
49.31	1.11	2.76	1.38	54.14	1.62
48.20	1.11	1.38	1.38	55.72	1.58
47.09	1.12	Proof.	Proof.	57.25	1.53
45.97	1.13	1.39	1.39	58.72	1.47
44.84	1.14	2.79	1.40	60.12	1.40
43.70	1.14	4.20	1.41	61.44	1.32
42.56	1.15	5.62	1.42	62.68	1.24
40.41	1.16	7.05	1.43	63.84	1.16
39.25	1.17	8.50	1.45	64.94	1.10
37.08	1.17	9.96	1.46	65.99	1.05
35.91	1.18	11.44	1.48	66.99	1.00
34.73	1.19	12.93	1.49	67.94	0.95
33.54	1.20	14.44	1.51	68.84	0.90
34.34	1.20	15.96	1.52	69.70	0.86
31.14	1.21	17.50	1.54	70.53	0.83
29.93	1.22	19.05	1.55	71.33	0.80

DESCENDING SCALE.					
68.97	0.97	29.48	1.26	20.62	1.55
68.00	0.97	28.22	1.27	22.18	1.56
67.03	0.97	26.95	1.28	23.75	1.57
66.06	0.98	25.67	1.28	25.33	1.58
65.08	0.98	24.39	1.29	26.91	1.58
64.10	0.98	23.10	1.30	28.50	1.59
63.12	0.99	21.80	1.31	30.10	1.60
62.13	0.99	20.49	1.31	31.71	1.61
61.14	0.99	19.18	1.32	33.33	1.62
60.15	1.00	17.86	1.33	34.96	1.63
59.15	1.00	16.53	1.34	36.60	1.64
58.15	1.00	15.19	1.35	38.25	1.65
57.15	1.01	13.84	1.35	39.91	1.66
56.14	1.02	12.49	1.36	41.58	1.67
55.12	1.04	11.13	1.37	43.25	1.67
54.08	1.06	9.76	1.38	44.91	1.66
53.02	1.08	8.38	1.39	46.57	1.66
51.94	1.10	6.99	1.39	48.22	1.65
50.84	1.11	5.60	1.39	49.86	1.64
49.73	1.12	4.21	1.40	51.49	1.63
48.61	1.13	2.81	1.40	53.11	1.62
47.48	1.14	1.41	1.41	54.72	1.61
46.34	1.15	Proof.	Proof.	56.31	1.59
45.19	1.16	1.42	1.42	57.86	1.55
44.03	1.17	2.85	1.43	59.36	1.50
42.86	1.18	4.28	1.43	60.80	1.44
41.68	1.19	5.72	1.44	62.18	1.38
40.49	1.19	7.17	1.45	63.51	1.33
39.30	1.20	8.62	1.45	64.80	1.29
38.10	1.21	10.08	1.46	66.05	1.25
36.89	1.22	11.55	1.47	67.26	1.21
35.67	1.22	13.03	1.48	68.43	1.17
34.45	1.23	14.52	1.49	69.56	1.13
33.22	1.24	16.02	1.50	70.66	1.10
31.98	1.25	17.54	1.52	71.73	1.07
30.73	1.25	19.07	1.53	72.77	1.04

The points given in these Tables after being each divided into four, and applied to the sides of the indicating scale, are to be numbered, beginning in the ascending scale from the bottom, and in the descending scale from the top. It will be sufficient perhaps to number every fourth division as shown in figure 1, plate XXIV. Figure 3 shows the size which the divisions might be made on the back of a moderate thermometer, by which it will be seen that tenths, or even half tenths, may be read with ease; and it appears that it would be by no means superfluous to use a thermometer sensible enough to show half or quarter degrees, when it is seen that one degree affects the apparent strength of the spirit from three to four tenths per cent; if this were done, it would be necessary that each fourth of the divisions in the above Tables, should be again divided to correspond to the effects produced by half degrees of temperature.

A. AINGER.

N° XIX.

IMPROVED MODE OF OPENING AND
SHUTTING CHURCH WINDOWS.

The SILVER VULCAN MEDAL was this Session given to Mr. W. BAILEY, 272, High Holborn, for an IMPROVED MODE OF OPENING AND SHUTTING THE WINDOWS OF CHURCHES AND OTHER PUBLIC BUILDINGS, FOR THE PURPOSE OF VENTILATION. The following Communication has been received from Mr. BAILEY on the Subject, and a Model of his Invention has been placed in the Repository of the Society.

SIR ;

272, Holborn, May 7th, 1822.

I WILL thank you, to lay before the Society, the following communication on an improvement in the mode of opening church windows, and other fixed sashes; and which is generally applicable to halls, courts of justice, assembly rooms, and all places that from their crowded state may require extensive ventilation.

To exemplify the operation more fully than could be done by mere description, I have sent a glazed model of a window formed with solid wrought iron sash bars: which bars I have extensively applied in the erection of curvilinear hot-houses, green-houses, and conservatories, their strength and lightness

rendering them well adapted to the construction of every description of lights and sashes.

It has long been a subject of complaint, that our churches and public edifices, are kept too close and confined for the health and the comfort of the large congregations that assemble in them. Various contrivances attached to the windows, for the emission of the foul air, and the admission of fresh air, so necessary for the purpose of ventilation have been adopted, and more particularly in our churches, but none of them have been applied where their action would be most efficacious ; which is at the upper portion of the window, and few of them without producing effects equally inconvenient as those they are intended to remedy.

The old mode was, by means of casements hung upon hinges, and fastening with a latch, these to be within reach were necessarily placed very low, and consequently when opened produced only a trifling ventilation, while the admitted air coming immediately on the persons near them, was extremely inconvenient, and prevented the casements being often opened.

A later and improved mode has been to hang the casements to swing on center pivots, and to place them about the middle of the windows, so that when open one part of the casement is on the inside of the church, and the other part on the outside. This mode is liable to the objection of the air falling on the heads of the persons assembled, and its affording no defence against the admission of a shower of rain. These casements also require pullies and lines, hanging in the middle of the window to open and shut them, operations generally accompanied with considerable noise and consequent disturbance.

Another mode that has been lately very much adopted is to cut out of the windows, a space to receive the half of a glazed hopper, which is attached to the window projecting inwards,

having a flap on the top, lying horizontally, and opening upwards. These hoppers are extremely unsightly in themselves, but are rendered still more so by the dust which falls and lodges on them, and they are subject to the further inconvenience of the dust being blown into the church when the flap is raised for the admission of air.

I flatter myself on the inspection of the model which I have the honour of submitting to the Society, it will be found that the above stated inconveniencies are obviated and a ready mode of action on the upper part of the window is obtained, by means of simple and effective machinery, while the symmetry of the window is preserved. It may be proper to observe, that in case of the upper part of the window being square, and not having any mullions, it will be found necessary (to prevent the entrance of the air at the sides of the casement when it opens), to have a frame with two angular glazed sides attached to the windows, and these sides must have a small return rebate for the casement to fall against when it is fully opened, which will effectually prevent any inconvenience arising from the form of the window.

I am, Sir,

A. Aikin, Esq.,
Sec., &c. &c.

&c. &c. &c.

WM. BAILEY.

P. S. I have inclosed a certificate from the minister and churchwardens, of the parish of St. Anne's Aldersgate street, who have had these windows in use since 1820.

CERTIFICATE.

Vestry-room of St. Anne's,
April 24th, 1822.

SIR ;

WE beg to certify, that Messrs. Baileys, in the summer of

1820, fixed in the church of the united parishes of St. Anne's St. Agnes, and St. John, Zachary, four of their iron-sash-bar-windows, with opening casements, which have been found to answer the purpose extremely well, and we think are so much superior to the windows commonly used in churches, and the usual modes of admitting air into them, that if they were generally known they would be universally adopted.

We are, Sir,
&c. &c. &c.

	JAMES HUTCHINS, A.M. <i>Minister.</i>	
A. Aikin, <i>Esq.</i>	W. MATTHEWS,	} <i>Churchwardens.</i>
Sec. &c. &c.	T. MAYFIELD,	

References to the Engraving of Mr. BAILEY's improved Mode of Opening and Shutting the Windows of Churches, and other Public Buildings —Plate XXI.

Fig. 1 is a front inside view of a window, with the apparatus attached.

Fig. 2 is a lateral view of the apparatus.

a is the flap of the window open, forming an angle of about 45 degrees with the plane of the sash.

b b a bar to which the base of the flap is fixed and on which it turns.

c a lever, having one end fastened to the extremity of the bar *b* and furnished at the other end with an eye, which receives the pin or stud *d*. This stud is fixed on the vertical rod *e*, which terminates below in a rack *f*, and is secured in an upright position by the loops or guides *g g* through which it passes.

h is a lanthorn pinion of two teeth, which when turned round by means of the winch *i*, take into the notches of the rack, and consequently draw down the rod *e*, or raise it, according to the direction in which the winch is turned.

In the first case the stud *d* draws the lever down, and consequently opens the window, which is the position represented in the plate; in the latter case the stud is raised and with it the lever, which closes the window.

Fig. 3 shows the rack with the parts connected with it on a large scale. *k* is a section of the lanthorn pinion, showing how its two teeth interlock with those of the rack so as to support the rack: the teeth are adjusted in such a manner that when the window is closed, the two teeth of the pinion are in a vertical position; this is necessary, because a two-leaved pinion cannot remain at the quarter turn.

Fig. 4 is a section of the box, in which the rack and pinion are contained (a front view of the box being shown in fig. 1). The square end of the axis of the pinion projects beyond the box, for the purpose of conveniently receiving the winch, and may itself be enclosed in a barrel to prevent it from being bent by any accident.

Fig. 5 shows the two-leaved pinion detached from the other parts of the apparatus.